Site-approved Ph.D. in Mechanical Engineering Program at IUPUI

SIGNATURE PAGE
FOR NEW DEGREE PROGRAM PROPOSAL

Degree Title: Ph.D. in Mechanical Engineering

Name of academic unit offering the new degree: Mechanical and Energy Engineering Department at Indiana University-Purdue University Indianapolis

Include signatures from all involved programs:

Approval recorded in Curriculog

Signature of Department Head
Department of Mechanical and Energy Engineering

Date

Approval recorded in Curriculog

Signature of Academic Dean
School of Engineering and Technology

Date

Approval recorded in Curriculog

Director of Graduate Studies
(for regional campuses)

Date

Approval Recommended by the Graduate Council

Approval recorded in Curriculog
Date

Approval recorded in Curriculog

Dean of the Graduate School

Date

Jay T. Akridge
Provost and Executive Vice President for
Academic Affairs and Diversity

2/18/19
Date

Mitchell E. Daniels, Jr.
President

2/19/19
Date

Purdue University Board of Trustees

1-PAGE EXECUTIVE SUMMARY

INTRA-AGENCY ADVISORY AND DELIBERATIVE MATERIAL

MEMORANDUM

Executive Summary of Upcoming Board Review or Action Item

DATE: October 1, 2018

TO: Board of Trustees

FROM: Jie Chen, Ph.D., Primary Contact, (317) 274-5918; jchen3@iupui.edu

CC: Sohel Anwar, Ph.D., Secondary Contact, (317) 274-7640; soanwar@iupui.edu

SUBJECT: *Submission of Proposal for Ph.D. Degree Program in Mechanical Engineering at IUPUI*

Purpose:

☐ This item is recommended for discussion by the Board in executive session.

☐ This item is recommended for discussion by the_____Committee at its meeting.

X **This item will require a formal vote by the Academic Affairs Committee at its meeting.**

☐ This item will require a formal vote by the Board in the Stated Meeting.

☐ This item will be presented in a formal resolution for action at the Stated Meeting.

Attachments: The following attachments accompany this memo:

Executive Summary (1-page)

Executive Summary

Ph.D. in Mechanical Engineering
Purdue School of Engineering and Technology
Indiana University-Purdue University Indianapolis

The Purdue School of Engineering and Technology at Indiana University-Purdue University Indianapolis (IUPUI) seeks to transition its current Ph.D. program under the cooperative agreement with the School of Mechanical Engineering at Purdue University, West Lafayette (PUWL) to an IUPUI site-approved Mechanical Engineering (ME) Ph.D. degree program. The Department of Mechanical and Energy Engineering (MEE) at IUPUI has been training Ph.D. students since 2004 under the cooperative agreement. It also had graduated six Ph.D. students before 2004 based on individual faculty collaborations. The Ph.D. program has experienced significant growth with a current enrollment of 35 students in Fall 2018. As the program becomes mature, further improvement is needed to resolve issues that hinder growth in order to train more researchers and engineers with Ph.D. degrees for contributing to the economic development of Indiana and beyond. A stronger Ph.D. program will also enhance the faculty's ability to conduct high quality research, which will benefit both research and learning, core missions of the university.

The program will train highly qualified and motivated baccalaureate and Master's degree holders to reach their career goals. The program is designed for full-time students, but will be open for part-time students who have joined the workforce, gained extensive experience, and desired to advance their career with a Ph.D. degree.

The proposed program will follow the admission and graduation requirements currently used under the cooperative agreement. The curriculum and administration will be customized to fit our constraints, opportunities, and needs. The curriculum will be based on the list of courses, which are offered currently at IUPUI. The students will have the option to take courses offered at PUWL if needed. The specializations of the program will be tailored based on our faculty strengths and needs. For example, we have added a specialization on energy and materials due to their potential impact on the economy and the high activity of research and strong track record of success in renewable energy in the department.

Graduates with the Ph.D. in ME are needed in academics, research institutions, and industry. The industrial needs have increased in recent years as indicated by INDEED, a national job searching organization. Moreover, nationwide data from the National Science Foundation have demonstrated that 99% of ME Ph.D. holders are employed. Our Ph.D. graduates have been well received by the market. Our data indicated that 100% of them are employed by universities, national labs, or industry. One of our part-time graduates is currently employed by the Ford Motor Company based on his Ph.D. training at IUPUI. Indiana companies, such as Rolls-Royce, Cummins, as well as small or startup companies, are hiring ME engineers with Ph.D. degrees.

The Department of MEE at IUPUI is ready for the site-approved Ph.D. program. The 18 highly qualified tenured/tenure-track faculty are committed to high quality research and teaching. They all have significant experience in supervising Ph.D. students. The department has been managing a Ph.D. program for fourteen years. The active research has resulted in external funding from government agencies, such as NSF, NIH, NASA, DOD and DOE, research foundations, and industry, which are stimulated by Ph.D. student involvement and enhance the Ph.D. program financially.

Cover Page

INSTITUTION: Purdue University

CAMPUS: Indiana University-Purdue University Indianapolis (IUPUI)

COLLEGE: School of Engineering & Technology

DEPARTMENT/SCHOOL: Department of Mechanical and Energy Engineering

DEGREE PROGRAM TITLE: Ph.D. in Mechanical Engineering

SUGGESTED CIP CODE:

PROJECTED DATE August 1, 2019

PROPOSAL

Ph.D. in Mechanical Engineering

Purdue School of Engineering & Technology

Indiana University-Purdue University Indianapolis

1. Characteristics of the Program

a. **Campus(es) Offering Program**: Indiana University-Purdue University Indianapolis (IUPUI)

b. **Scope of Delivery (Specific Sites or Statewide)**: IUPUI

c. **Mode of Delivery (Classroom, Blended, or Online)**: Classroom

d. **Other Delivery Aspects (Co-ops, Internships, Clinicals, Practica, etc.)**: Ph.D. students will be required to participate in research and have the option to complete internships related to their plan of study.

e. **Academic Unit Offering Program:** School of Engineering and Technology, IUPUI

f. **Department:** Mechanical and Energy Engineering

2. Rationale for Program

a. Institutional Rationale (e.g. Alignment with Institutional Mission and Strengths)

IUPUI is Indiana's urban research and academic health sciences campus with its missions "to advance the state of Indiana and the intellectual growth of its citizens to the highest levels nationally and internationally through research and creative activity, teaching and learning, and civic engagement." The engineering programs have contributed significantly to the rapid campus growth. A site-approved Ph.D. program is essential for strengthening the engineering programs in terms of image and reputation and serving the market needs of a Ph.D. level workforce. A strong Ph.D. program is also pivotal for supporting faculty research.

The Department of Mechanical and Energy Engineering (MEE) has been offering the Ph.D. program under a cooperative agreement of participation with the School of Mechanical Engineering (ME), Purdue University, West Lafayette (PUWL) since 2004. Prior to 2004, the faculty of MEE at IUPUI worked with the faculty in the School of ME at PUWL and graduated six Ph.D. students. These students were co-advised by the PUWL faculty, but were sponsored by the IUPUI faculty with the research work done at IUPUI. The high quality of the Ph.D. students' work led to the cooperative agreement approved in 2004. With the agreement in place, the number of Ph.D. students in the department has grown rapidly in recent years with the current enrollment reaching 35 Ph.D. students at IUPUI in Fall of 2018. The significant increase in the number of Ph.D. students is correlated very well with the rapid increase of research awards and

expenditures in the department in the recent years. These activities strongly support IUPUI's mission and strengthen the image and reputation of the campus.

The Department of MEE has faculty who are qualified and committed to train high quality Ph.D. students; and has the experience required for managing the Ph.D. program. All the Ph.D. advisors have Ph.D. degrees and strong publication records. The faculty's researches are supported by external research awards from government agencies and industry. These faculties have experience in supervising Ph.D. students, except the new hires. Moreover, the department is capable of managing the program. The MEE Department has been offering a site-approved MSME degree. We have also been running the Ph.D. program under the current cooperative agreement with the School of ME PUWL for thirteen years. The current agreement requires that all students be jointly supervised by faculty at IUPUI and PUWL. However, students apply to our program, and are admitted and enrolled at IUPUI with PUWL's approval.

The cooperative agreement requires special conditions for students admitted by IUPUI. Students need to take four PUWL courses, pass their qualifying exams, but conduct research entirely at IUPUI. The program has resulted in high quality Ph.D. students in the past 13 years thanks to the joint effort of the faculty on both campuses. Furthermore, doctoral students at IUPUI also benefit from services provided by the IUPUI campus, such as the NSF-sponsored consortium Center for Integration of Research, Teaching and Learning (CIRTL), which provides career development specifically for Ph.D. students.

Although the current program is successful, there are issues that need to be further improved, such as inconvenience due to travel requirements for new Ph.D. students who need to travel to WL for courses and take the qualifying exams, but may not have proper transportation means. The program does not attract engineers in local companies to work on Ph.D. part-time due to the same reasons. There are also administrative challenges for advisory committee meeting scheduling, student advising, and fund transferring for covering WL tuition. As the Ph.D. program grows, these issues become more prominent. The current agreement requires two WL faculty to be on each Ph.D. student's advisory committee. We appreciate the great effort from WL faculty to help us. However, there are issues associated with this requirement that hinder our growth. Each Ph.D. student needs a co-chair from WL at admission. It is hard for new faculty to establish the relationship with WL faculty immediately when they are hired, thus it will take time for them to recruit Ph.D. students, which negatively affects the faculty's productivity and is not attractive to recruit high quality faculty. In summary, the current agreement is workable when the number of Ph.D. students is small. With the rapid growth of ME Ph.D. program in terms of headcounts, a site-approved Ph.D. program is in urgent need and justified.

With rapid technology advancements, engineers with the Ph.D. are needed in research institutions, academics, and industry, including startup companies. National data demonstrate high employment rate of Ph.D. graduates in the mechanical engineering discipline. Situated in the capital of the state, the IUPUI campus is the center of the state's life science research and is surrounded by major companies, such as Eli Lilly and Company, Rolls- Royce, Carrier, Raytheon, Allison Transmission, as well as numerous small or medium size manufacturing companies. The success of these companies and

research institutions significantly affects the state's economy and depends on the quality of their workforce. Having a strong ME Ph.D. program at IUPUI will serve the market needs for well-trained researchers and high-level engineering professionals to conduct high-level research and development (R&D) work for the state, nation, and beyond.

In summary, the Department of MEE at IUPUI has demonstrated its ability to graduate high quality Ph.D. students and to manage the Ph.D. program. There is pressing need to expand the Ph.D. program to meet the research and market needs, which require solutions to the issues that hinder growth. Having a site-approved Ph.D. program is a solution.

b. State Rationale

The State of Indiana's economy relies on success of industry and research institutes, which requires well-educated engineers and researchers. The increasing demand is evidenced by the rapid growth of MEE's graduate program. The graduate credit hours have grown from 450 in 2005 to 3,177 in 2018, a 606% increase in thirteen years. The MSME student headcount has increased from 32 in 2005 to 180 in 2018, a 463% increase; and the number of Ph.D. students has increased from 1 in 2005 to 35 in Fall 2018. These are also indicators of the market need. Major companies, such as Rolls-Royce and Cummins, are constantly recruiting people with Ph.D. degrees in mechanical engineering, which are indicated by their supporting letters. Currently, two of our ME Ph.D. students are current Cummins employees. Traditionally, IUPUI graduates stay and build their careers in Indiana. Having a site-approved Ph.D. program at IUPUI will serve the state's need to retain highly educated engineers.

c. Evidence of Labor Market Need

i. National, State, or Regional Need

Graduates with a Ph.D. in Mechanical Engineering are employed in industry, academics, and national labs. The demand has been strong, and is supported by the statistics reported by the National Center for Science and Engineering Statistics (NCSES) of the National Science Foundation (NSF); and a survey of the Ph.D. job market reveals that local companies, such as Cummins and Rolls-Royce, need Ph.D. level mechanical engineers. According to NCSES's 2013 report, https://ncsesdata.nsf.gov/doctoratework/2013/index.html, unemployment among doctoral engineers in mechanical engineering was about 1% with a 95% confidence; the unemployment rate of the graduates within the last 5 years was <1%, meaning 99% of the graduates in mechanical engineering were employed within 1 year after graduation. This low unemployment rate is a clear indication for high demand of Ph.D. holders in Mechanical Engineering. Of these employed Ph.D. engineers, 26% worked in academia, 58% in private for profit organizations, with the remainder working in private non-profit, government, or self-employed entities, https://www.nsf.gov/statistics/infbrief/nsf14317/.

ii. Preparation for Graduate Programs or Other Benefits

A Ph.D. in Mechanical Engineering is a terminal degree.

iii. Summary of Indiana DWD and/or U.S. Department of Labor Data

The demand for mechanical engineering graduates is strong. Based on the data published by the Bureau of Labor Statistics of the United States Department of Labor, https://www.bls.gov/ooh/architecture-and-engineering/mechanical-engineers.htm, the ME job outlook from 2014 to 2024 will see an average 5% increase. Indiana is listed as the top five states with the highest concentration of jobs and location quotients in mechanical engineering. The statistics clearly indicate the need for mechanical engineers in the nation and the state.

iv. National, State, or Regional Studies

In the *NACE Job Outlook Survey for 2016* (National Association of Colleges and Employers, https://www.naceweb.org/tag/hiring-outlook/,) in their job outlook for doctoral degrees, the top five doctoral degrees for which employers expressed their greatest need are in order: i) Electrical Engineering, ii) Computer Science, iii) Software Engineering, iv) Computer Engineering and iv) Mechanical Engineering (with the last two tied).

v. Surveys of Employers or Students and Analyses of Job Postings

The Ph.D. graduates are in high demand. Indeed.com, a nationwide job-searching engine, showed that there are 1,842 job openings nationwide for Ph.D. in Mechanical Engineering, https://indeed.com. Out of these, 31 job openings are in Indiana, with associated companies like Cummins, Rolls-Royce, Cook Advanced Technologies, Med Institute Inc., etc. Having a site-approved Ph.D. program in the capital of the state where these companies are close by will better serve their needs, through internship, collaborative research, and course offering.

vi. Letters of support (Appendix C)

- Steve Wellborn and Lisa J. Teague, Head, Rolls-Royce
- Thomas J. Stephens, Director, Hardware & Technology, Raytheon IIS
- Wayne Eckerle, Vice President - Corporate Research and Technology, Cummins Inc.
- Hernando Munevar, President & CEO, Candent Technologies

3. Cost of and Support for the Program

a. Costs

• Faculty and Staff

The Department of Mechanical and Energy Engineering has eighteen tenure-track/tenured faculty, two tenure-track faculty with secondary appointments with this department, one clinical associate professor, two lecturers, and one visiting assistant professor who has a joint appointment with the IU McKinney School of Law. One

tenure-track faculty position has been approved and the search is ongoing. The faculty have the expertise to cover the proposed specification areas, actively conduct research in these areas, and cover the courses that we have developed for the Ph.D. program. The department also has good staff support, which includes two student advisors, a laboratory supervisor, and two office staff. One of the advisors is primarily responsible for the graduate programs. Another advisor position has been approved, which will strengthen our ability to manage the site-approved Ph.D. program. The department has been running an autonomous MSME program and managing the Ph.D. program under the cooperative agreement with PUWL. The advising staff have been managing every aspect of graduate programs including admission, monitoring student progress, and graduation. Therefore, no additional faculty and staff are needed to implement the proposed Ph.D. program.

• ***Facilities***

The current facilities are adequate for the Ph.D. program. We have been running the Ph.D. program under the cooperative agreement with WL for thirteen years. The growth of the Ph.D. headcount has been driven by the increasing research and teaching activities, and thus is self-sustained. The rapid program growths helped approval of construction of a new building, which consists of significant research spaces allocated for the department. Although the current facilities are adequate, the new building will definitely help the new Ph.D. program advance. No additional facilities are necessary for the proposed Ph.D. program.

• ***Other Capital Costs (e.g. Equipment)***

The current equipment is adequate for the Ph.D. program. The equipment needed for the program is research related, which has been supported by research funding resulting from increasing research activities. No additional equipment is necessary for the proposed Ph.D. program.

b. Support

• ***Nature of Support (New, Existing, or Reallocated)***

The nature of support of this Ph.D. program is self-sustained. The growth of Ph.D. students increases research activities, resulting in more research funding, which generates revenues to further support the program. The historic data shows that the increasing of Ph.D. headcount correlates well with rising research expenditures. Furthermore, the department already has graduate assistant support in the base budget, which has been increasing in the recent years. The department also has received increasing funding from the block grant due to high research activities. As the number of Ph.D. students increase, the resulting research activities will result in more funding. The department will gradually reallocate the funds to increase support of Ph.D. students, which is a common practice in major research institutions.

• ***Special Fees above Baseline Tuition***

There will be no special fees associated with this proposed Ph.D. program.

4. Similar and Related Programs

a. List of Programs and Degrees Conferred

• Similar Programs at Other Institutions

There are only two ME Ph.D. programs in Indiana, which are offered by Purdue University, West Lafayette and Notre Dame. There are ME Ph.D. programs in many neighboring states, such as University of Cincinnati, University of Louisville, University of Illinois Chicago, University of Illinois Urbana Champaign, University of Dayton, University of Wisconsin Milwaukee, Wayne State University, etc.

• Related Programs at the Proposing Institution

There is no ME Ph.D. program in the Indiana University system.

b. List of Similar Programs Outside Indiana

There are ME Ph.D. programs in many neighboring states, such as the University of Cincinnati, University of Louisville, University of Illinois Chicago, University of Illinois Urbana Champaign, University of Dayton, University of Wisconsin Milwaukee, Wayne State University, etc. In general, most of major research universities, including IUPUI, have ME Ph.D. programs. Surveying a list of top 40 populated metropolitan areas, Indianapolis was the only metropolitan area that did not have a nearby (within 15 miles) site-approved ME Ph.D. program.

c. Articulation of Associate/Baccalaureate Programs

Not applicable

d. Collaboration with Similar or Related Programs on Other Campuses

The department currently has an ME Ph.D. program under a cooperative agreement with the School of Mechanical Engineering, Purdue Univeristy, West Lafayette. The program has been successful. However, this proposed program addresses issues that hinder the growth of the Ph.D. program at IUPUI, as well as improve the overall student experience and satisfaction.

5. Quality and Other Aspects of the Program

a. Credit Hours Required/Time To Completion

The credit hours required for graduation are 90 after the students complete the bachelor degree, which is the same as PUWL.

b. Exceeding the Standard Expectation of Credit Hours

Not applicable

c. Program Competencies or Learning Outcomes

The graduates who receive a Ph.D. degree from this proposed program are expected to be able to independently solve complex problems. The learning outcomes of the program are:

1. Demonstrate an in-depth knowledge of fundamental theories in the discipline.
2. Demonstrate competency in solving complex problems.
3. Define and formulate original research problem and develop appropriate methodologies to solve problems effectively.
4. Learn the state of the art in the chosen specialization through literature reviews and identify the needs for further developments.
5. Apply skills to design solid methodologies, algorithms/techniques, and experiments to solve complex problems with real data.
6. Innovate new methodologies, techniques, theories, or algorithms through the process of solving the problem at hand.
7. Demonstrate critical thinking and creativity in problem solving.
8. Analyze and interpret the data adequately.
9. Disseminate and communicate research results to peers through high quality journal publications and conference presentations/publications.

d. Assessment

The assessment of the program will be focused on its reputation and quality reflected by its learning outcomes

Reputation

1. Number of applicants vs. admitted students.
2. Quality of the applicants in terms of GPA and GRE scores.
3. Number of matriculated students.

Quality

1. Student cumulative GPA.
2. Research productivity measured by the number of student journal publications and conference presentations/publications.
3. Time to degree completion.
4. Number of Ph.D. graduates per year, and,
5. Graduate placement in terms of employment rate and type of jobs secured.

Data will be collected twice a year and analyzed annually for program improvement. The Chair of the Graduate Education and Research Committee (GERC) will be responsible to lead the committee to assess the outcomes and recommend for improvements annually.

e. Licensure and Certification

The Ph.D. program is not intended to offer specific licenses and certifications.

f. Placement of Graduates

Students in the ME programs have access to the career services provided by both PUWL and IUPUI. The Purdue School of Engineering and Technology at IUPUI also has a career services organization that connects our graduates to potential employers, helps students prepare resumes, and provides job related consultations.

g. Accreditation

Program specific accreditation, such as from ABET Inc., is not typically pursued for an engineering Ph.D. program.

6. Projected Headcount and FTE Enrollment and Degrees Conferred (see tables provided)

Since the start of the cooperative agreement in 2004, the current Ph.D. program has experienced constant growth, with a major increase of enrollment in recent years. In 2017, 27 applicants applied, 12 were admitted and 10 enrolled, (Table 1). The overall headcount of Ph.D. students in the program has reached 35 in Fall 2018, increasing from 1 in Fall 2005, (Figure 1). The MSME program has also experienced significant growth with the headcount increasing from 38 to 180 during the same period, (Figure 2). Thirteen students have graduated with a Ph.D. in Mechanical Engineering and were employed as researchers in Argonne National Lab, academic institutions and industry, (Table 2).

It is anticipated that both full-time (FT) and part-time (PT) students will be admitted. A FT student is considered as 1 FTE and a PT student as 0.5 FTE. Based on the enrollment trend and the number of research faculty in the department, we expect that the headcount of Ph.D. students enrolled in the site-approved Ph.D. program will reach 30 in five years in addition to the Ph.D. students who are currently enrolled under the current cooperative agreement. Four of them will be part-time Ph.D. students recruited from industry (Table 3). The annual totals of ME Ph.D. enrollments in terms of credit hours, full-time/part time status, headcount, or FTE, are described in Table 4.

Table 1 Enrollment data in the past three semesters

PhD ME Statistics			
Term	Fall 2016	Spring 2017	Fall 2017
Applied	17	6	21
Admitted	8	3	9
Denied	6	3	5
Deferred	0	0	4
Withdrawn	2	0	3
Incomplete	1	0	0
Enrolled	8	2	8

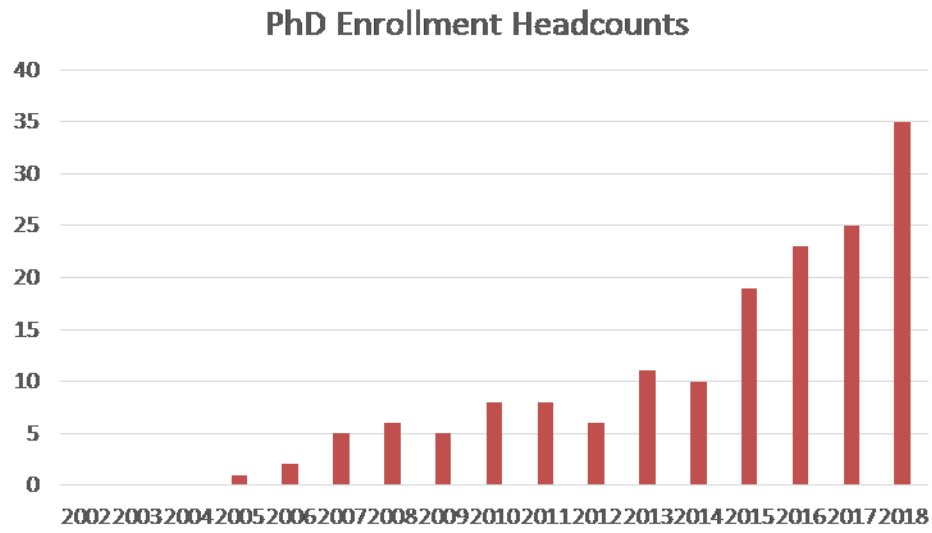

Figure 1 ME Ph.D. student headcounts from 2002 to 2018

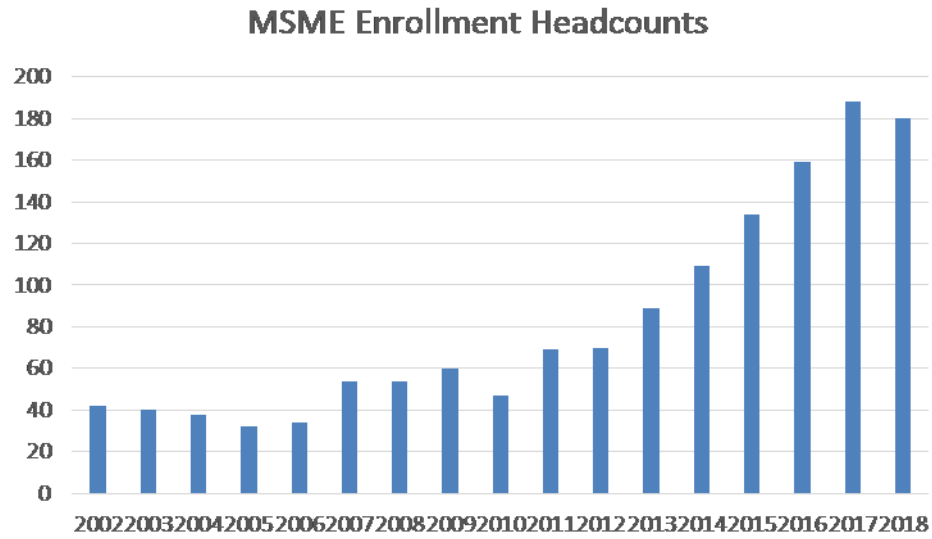

Figure 2 ME MSME student headcounts from 2002 to 2018

Table 2 Ph.D. students graduated from the current program

List of ME Ph.D. students within the cooperative agreement between ME (IUPUI) and ME (Purdue) who have graduated				
Name	IUPUI Advisor	Current working place	Yr. of Graduation	Job title
Li, Shuning	Jie Chen	IUPUI	2014	Faculty
Jiang, Feifei	Jie Chen	IUPUI	2015	Postdoc Fellow
Hongwei Li	Razi Nalim	Technical University of Denmark	2009	Research Scientist
Viktor Kilchyk	Razi Nalim	Praxair (previously with Brookhaven National Lab)	2009	Aerodynamics Engineer
Sameera Wijeyakulasuriya	Razi Nalim	Convergent Science	2011	Principal Engineer
Majid Deldar	Sohel Anwar	Meggitt Control System, Los Angeles, CA	2016	Senior Performance Analyst
Cheolwoong Lim	Likun Zhu	Millibatt Inc.	2017	Engineer
Guo, Xingye	Jing Zhang	Beijing University of Technology	2016	Faculty
Wou, Soungjin	azim El-Mounay	Ford Motor Co.	2012	Engineer
Promyoo, Rapeepan	azim El-Mounay	IUPUI	2016	postdoc Fellow
Liu, Qi	Jian Xie	Argonne National Laboratory	2014	Postdoc Fellow
List of Ph.D. students who were supervised by our faculty when working in other institutions or enrolled in other program				
Qian, Haihong	Jie Chen	Kean University	2001	Faculty
Bandi, Punit	Andres Tovar	Univ. of Notre Dame	2012	Vehicle Optimization Engineer, GM
Sarmiento, Luis Carlos	Andres Tovar	National Univ. of Colombia	2016	Faculty
Nathanial Hollingsworth	Diane Wagner	Kimberly Clark	2011	Research Scientist
Ali Vahdati	Diane Wagner	BD (Becton Dickinson and Company)	2012	Senior Engineer
Megan McGann	Diane Wagner	Purdue Polytechnic Insitute	2013	Clinical Associate Professor
Holly Weiss-Bilka	Diane Wagner	University of Notre Dame	2013	Postdoctoral Researcher
Andrew Steward	Diane Wagner	Zimmer Biomet	2014	Regulatory Affairs Associate
Craig Bonitsky	Diane Wagner	Curtiss-Wright	2015	Stress Analyst

Table 3 Data for Question #6 – Program enrollments and completions (Table 3.1), total direct program cost and program revenue (Table 3.2a), detail on incremental or out-of-pocket direct program costs (Table 3.2b), and new academic degree program proposal summary (Table 3).

Table 3.1 Program enrollments and completions

TABLE 1: PROGRAM ENROLLMENTS AND COMPLETIONS
Annual Totals by Fiscal Year (Use SIS Definitions)

	Year 1 2019-20	Year 2 2020-21	Year 3 2021-22	Year 4 2022-23	Year 5 2023-24
A. Program Credit Hours Generated					
1. Existing Courses	90	198	306	432	504
2. New Courses	0	0	0	0	0
Total	90	198	306	432	504
B. Full-time Equivalents (FTEs)					
1. Generated by Full-time Students	5	10	15	22	26
2. Generated by Part-time Students	0	1	2	2	2
Total	5	11	17	24	28
3. On-Campus Transfers	0	0	0	0	0
4. New-to-Campus	0	0	0	0	0
	0	0	0	0	0
C. Program Majors (Headcounts)					
1. Full-time Students	5	10	15	22	26
2. Part-time Students	0	2	4	4	4
Total	5	12	19	26	30
3. On-Campus Transfers	0	0	0	0	0
4. New-to-Campus	0	0	0	0	0
	0	0	0	0	0
5. In-State	0	2	3	5	5
6. Out-of-State	5	10	16	21	25
Total	5	12	19	26	30
D. Program Completions				4	6

Campus: Indiana University-Purdue University Indianapolis
Program: Site-approved PhD Program
Date: January 2019

Table 3.2a Total direct program cost and program revenue

TABLE 2A:
TOTAL DIRECT PROGRAM COSTS AND SOURCES OF PROGRAM REVENUE

	Year 1		Year 2		Year 3		Year 4		Year 5	
	FTE	2019-20	FTE	2020-21	FTE	2021-22	FTE	2022-23	FTE	2023-24
A. Total Direct Program Costs										
1. Existing Departmental Faculty Resources										
2. Other Existing Resources										
3. Incremental Resources (Table 2B)		166,000		229,000		292,000		380,200		430,600
TOTAL		$ 166,000		$ 229,000		$ 292,000		$ 380,200		$ 430,600
B. Sources of Program Revenue										
1. Reallocation		$ 166,000		$ 229,000		$ 292,000		$ 380,200		$ 430,600
2. New-to-Campus Student Fees										
3. Other (Non-State)				0		0		0		0
4. New State Appropriations										
a. Enrollment Change Funding		0		0		0		0		0
b. Other State Funds		0		0		0		0		0
TOTAL		$ 166,000		$ 229,000		$ 292,000		$ 380,200		$ 430,600

Campus:	Indiana University-Purdue University Indianapolis
Program:	Site-approved PhD Program
Date:	January 2019

Table 3.2b Detail on incremental or out-of-pocket direct program costs

TABLE 2B:
DETAIL ON INCREMENTAL OR
OUT-OF-POCKET DIRECT PROGRAM COSTS

	Year 1		Year 2		Year 3		Year 4		Year 8	
	FTE	2019-20	FTE	2020-21	FTE	2021-22	FTE	2022-23	FTE	2023-24
1. Personnel Services										
a. Faculty	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
b. Support Staff	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
c. Graduate Teaching Assistants	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Total Personnel Services		0		0		0		0		0
2. Supplies and Expense										
a. General Supplies and Expense		0		0		0		0		0
b. Recruiting		3,000		3,000		3,000		3,000		3,000
c. Travel		0		0		0		0		0
d. Library Acquisitions		0		0		0		0		0
Total Supplies and Expense		3,000		3,000		3,000		3,000		3,000
3. Equipment										
a. New Equipment Necessary for Program				0		0		0		0
b. Routine Replacement										0
Total Equipment		0		0		0		0		0
4. Facilities		0		0		0		0		0
5. Student Assistance										
a. Graduate Fee Scholarships*		63,000		126,000		189,000		277,200		327,600
b. Fellowships**		100,000		100,000		100,000		100,000		100,000
Total Student Assistance		163,000		226,000		289,000		377,200		427,600
Total Incremental Direct Costs		$ 166,000		$ 229,000		$ 292,000		$ 380,200		$ 430,600

* Costs will be covered by the school in a form of subsidizing the difference between in-state and out-state tuition

** Cost will be covered by the Graduate Assistant fund within MEE Departmental base budget

Table 3 New academic degree program proposal summary

TABLE 3:
NEW ACADEMIC DEGREE PROGRAM PROPOSAL SUMMARY
January 2019

I.	Prepared by Institution						
	Institution/Location:	Indiana University-Purdue University Indianapolis					
	Program:	Site-approved PhD Program					
	Proposed CIP Code:						
	Base Budget Year:	2019-2020					
		Year 1 2019-20	Year 2 2020-21	Year 3 2021-22	Year 4 2022-23	Year 5 2023-24	
	Enrollment Projections (Headcount)	5	12	19	26	30	
	Enrollment Projections (FTE)	5	11	17	24	28	
	Degree Completion Projection	0	0	0	4	6	
	New State Funds Requested (Actual)	$ 0	$ 0	$ 0	$ 0	$ 0	
	New State Funds Requested (Increases)	$ 0	$ 0	$ 0	$ 0	$ 0	
II.	Prepared by Commission for Higher Education						
	New State Funds to be Considered for Recommendation (Actual)	$	$	$	$	$	
	New State Funds to be Considered for Recommendation (Increases)	$	$	$	$	$	
	CHE Code:	Comment:					
	Campus Code:						
	County Code:						
	Degree Level:						
	CIP Code:						
Campus:	Indiana University-Purdue University Indianapolis						
Program:	Site-approved PhD Program						
Date:	January 2019						

Appendices

Appendix A Curriculum

- **Appendix A.1 Curriculum and Requirements**
- **Appendix A.2 Ph.D. Program Handbook**

Appendix B Faculty

- **Appendix B.1 Faculty**
- **Appendix B.2 Brief CV of the graduate faculty**
- **Curriculum Vitae of Graduate Faculty who supervises Ph.D. students**

Appendix C Supporting letters

- **Appendix C.1 Supporting letter from the Dean, College of Engineering, and Head, School of Mechanical Engineering, Purdue University**
- **Appendix C.2 Supporting letters from Industry**

Appendix A

A.1 Curriculum and Requirements

• Admissions Requirements

Application

The admission standards of the School of Mechanical Engineering at Purdue, WL (PUWL) will be followed. Students will apply to the Department of MEE (IUPUI) directly with a complete application. The MEE department has a graduate coordinator who manages and monitors the applications as well as coordinates the review of the applications with the departmental Graduate Education and Research Committee (GERC). Once an applicant is recommended for admission, the application will be forwarded to the Purdue University Graduate School for final approval.

A complete application includes:

- Official transcripts from all undergraduate and graduate institutions the applicant has attended
- Official scores of Graduate Record Exam (GRE)
- Three official letters of recommendations
- Copies of official diploma of each degree already completed
- Statement of Purpose
- Resume
- Evidence of English Proficiency required for international applicants, whose native language is not English, such as TOEFL

General admission requirements

The department will accept two types of Ph.D. applicants, Direct Ph.D. (DPh.D.) and Ph.D. applicants who already have a master's degree. All applicants must have earned at least a baccalaureate degree from a U.S. accredited institution or an equivalent degree from a foreign institution. The applicants must submit complete applications. The applications will be reviewed and recommended by the department's GERC to determine admission or rejection. Admissions will be forwarded to the PU Graduate School for final approval. The same criteria that have been used under the cooperative agreement will be used for admission of the Ph.D. students with a Master's degree. The criteria for admitting DPh.D. applicants used by PUWL will be followed closely, (Table 3).

Ph.D.

- MS cumulative GPA > 3.2
- Completion of Master's degree

- Minimum GRE score for Ph.D. with MS degree: None

DPh.D.

- Undergraduate GPA > 3.5
- Completion of Baccalaureate degree
- Minimum GRE scores for Direct Ph.D.: 150 verbal, 161 quantitative and 3.5 analytical

Table 3 Ph.D. admission requirements

Requirement	DPh.D.	Ph.D.
Undergraduate GPA	$\geq$ 3.5	$\geq$ 3.2
MS	None	Required
Minimum GRE score	150 verbal, 161 quantitative and 3.5 analytical	None

International applicants

- Minimum scores required for admission:
  - Paper Based Test: 575
  - Internet Based Test (IBT) minimums:
    - Total: 80
    - Reading: 19
    - Listening: 15
    - Speaking: 18
    - Writing: 18
  - IELTS minimum of 6.5 is acceptable as an alternative to TOEFL
  - Pearson Test of English (PTE) minimum of 58 is also accepted as an alternative to TOEFL

Curriculum Requirements

Course Requirements

All Ph.D. students are required to choose one of the following specializations: Thermal and Fluid Sciences; Solid Mechanics, Biomechanics, or Design; Mechatronics and Controls; and Energy and Materials. Curriculum requirements depend on the student type, Direct Ph.D. or Ph.D. admit with MS degree (Table 4).

Table 4 Credit and course requirements

Requirement	DPh.D.	Ph.D.
Total credit hours	90	90 (with 30 hours allowed to be transferred in from MS)
Non-thesis Course credits	36	21 beyond MS degree
Non-thesis courses	• 3 math courses with 2 from Math Dept. • ≥1 6XXXX level course	• 3 math courses with 2 from Math Dept. (may be partially fulfilled with courses taken in the MS program) ≥1 6XXXX level course
Allowed ME59700/69700 Independent Project credits	3	3
Seminar course	≥2 semesters	≥2 semesters
Remedial courses allowed for POS	0	0

Graduation requirements

1. Complete all courses in the approved Plan of Study (POS).
2. Successfully complete at least two semesters of the "ME 59800: ME Graduate Seminar" course.
3. Attain a minimum POS index of 3.00. The POS index for Ph.D. students is based on courses taken at IUPUI, which apply toward the Ph.D. and have not previously applied toward the Master's degree. In exceptional cases, a student with a POS index ≥ 2.85 may be certified for graduation and allowed to graduate if the Advisory Committee of the student recommends to the Graduate School that the student has met all expectations/requirements of the degree and the request is endorsed by the ME Chair of GERC.
4. Pass the Ph.D. Area Examinations.
5. Pass the Oral Preliminary Examination.
6. Complete the dissertation to the satisfaction of the Examining Committee and the Department of MEE.
7. Complete a minimum of 90 credit hours in coursework and research (ME69900).

• Sample Curriculum

GRADUATE SCHOOL

Request for PhD Degree Advisory Committee and Plan of Study Approval

(Please read instructions on reverse side.)

Pg. 1 of 1 Pgs. Date Degree Expected

1. NAME OF STUDENT XXX XXXX PUID No. /IUPUI

2. DEPARTMENT Mechanical and Energy Engineering Dept. Code MECH

Degree Title PhD Degree Code ME-PHD Research Area

3. AREA OF SPECIALIZATION (if any) Thermal and Fluid Sciences AOS Code

Area	4. COURSES				5. METHOD OF ESTABLISHING CREDIT			6. DATE COMPLETED OR TO BE COMPLETED
	OFFICIAL TITLE ABBREVIATION *Please group courses into "Primary" (P) & "Related" (R) areas.*	Subject Abbr.	Course No.*	Cr. Hours	Regular Regis.	Non-degree Regis.	Other or Transfer From +	
P	Thermodynamics	ME		3			Other University	
P	Heat and Mass Transfer	ME		3			Other University	
P	Intermediate Fluid Mechanics	ME		3			Other University	
R	Advanced Stress Analysis	ME		3			Other University	
R	Numerical Methods in Mechanical Engineering	ME		3			Other University	
R	Advanced Applied Mathematics I	Math		3			Other University	
R	Advanced Applied Mathematics II	Math		3			Other University	
P	Gas Dynamics	ME	51000	3				
P	Design Optimization Methods	ME	50601	3				
P	Combustion	ME	52500	3				
P	Computational Fluid Dynamics	ME	61400	3				
R	Finite Element Analysis	ME	55100	3				
R	Linear Algebra	Math	51100	3				
R	CAD/CAM Theory and Applications	ME	54600	3				

7. LANGUAGE REQUIREMENTS	Method to be used to meet language requirements
a.	a.
b.	b.

\+ Transfer course must be described as on original transcript.
* Mark course number with asterisk (*) if B or better is required.

8. NAMES OF ADVISORY COMMITTEE MEMBERS (Please type full name.)	9. GRADUATE FACULTY IDENTIFIER	APPROVED BY ADVISORY COMMITTEE MEMBERS (Signature)	10. DEPARTMENT Abbr.	10. DEPARTMENT Code	11. ADVISOR IN AREA OF:
Chair		Chair			

☐ Check here if supplemental notes or other requirements are attached.

13. APPROVED BY:

Head of the Graduate Program Date

12. SIGNATURE OF STUDENT Date

Academic Dean (if required) Date

Graduate School Dean

Submit original plus one copy to the Graduate School.

Comments, special notes, or other requirements:

GRADUATE SCHOOL

Request for PhD Degree Advisory Committee and Plan of Study Approval

(Please read instructions on reverse side.)

Pg. 1 of 1 Pgs. Date Degree Expected

1. NAME OF STUDENT XXX XXXX PUID No. /IUPUI

2. DEPARTMENT Mechanical and Energy Engineering Dept. Code MECH

Degree Title PhD Degree Code ME-PHD Research Area

3. AREA OF SPECIALIZATION (if any) Energy and Materials AOS Code

Area	4. COURSES				5. METHOD OF ESTABLISHING CREDIT			6. DATE COMPLETED OR TO BE COMPLETED
	OFFICIAL TITLE ABBREVIATION *Please group courses into "Primary" (P) & "Related" (R) areas.*	Subject Abbr.	Course No.*	Cr. Hours	Regular Regis.	Non-degree Regis.	Other or Transfer From +	
P	Thermodynamics	ME		3			Other University	
P	Heat and Mass Transfer	ME		3			Other University	
P	Intermediate Fluid Mechanics	ME		3			Other University	
R	Mechanical Vibrations	ME		3			Other University	
R	Numerical Methods in Mechanical Engineering	ME		3			Other University	
R	Advanced Applied Mathematics I	Math		3			Other University	
R	Advanced Applied Mathematics II	Math		3			Other University	
P	Energy Management Principles	ME	50102	3				
P	Energy Storage Devices and Systems	ME	51200	3				
P	Introduction to Renewable Energy	ME	54200	3				
P	Fuel Cell Science and Engineering	ME	54800	3				
R	Hybrid and Electric Transportation	ME	50105	3				
R	Linear Algebra	Math	51100	3				
R	Computational Fracture Mechanics	ME	69700	3				

7. LANGUAGE REQUIREMENTS	Method to be used to meet language requirements
a.	a.
b.	b.

\+ Transfer course must be described as on original transcript.
* Mark course number with asterisk (*) if B or better is required.

8. NAMES OF ADVISORY COMMITTEE MEMBERS (Please type full name.)	9. GRADUATE FACULTY IDENTIFIER	APPROVED BY ADVISORY COMMITTEE MEMBERS (Signature)	10. DEPARTMENT Abbr.	10. DEPARTMENT Code	11. ADVISOR IN AREA OF:
Chair		Chair			

☐ Check here if supplemental notes or other requirements are attached.

13. APPROVED BY:

Head of the Graduate Program Date

12. SIGNATURE OF STUDENT Date

Academic Dean (if required) Date

Graduate School Dean

Submit original plus one copy to the Graduate School.

Comments, special notes, or other requirements:

GRADUATE SCHOOL

Request for PhD Degree Advisory Committee and Plan of Study Approval

(Please read instructions on reverse side.)

Pg. 1 of 1 Pgs. Date Degree Expected

1. NAME OF STUDENT XXX XXXX PUID No. /IUPUI

2. DEPARTMENT Mechanical and Energy Engineering Dept. Code MECH

Degree Title PhD Degree Code ME-PHD Research Area

3. AREA OF SPECIALIZATION (if any) Mechatronics and Controls AOS Code

Area	4. COURSES				5. METHOD OF ESTABLISHING CREDIT			6. DATE COMPLETED OR TO BE COMPLETED
	OFFICIAL TITLE ABBREVIATION *Please group courses into "Primary" (P) & "Related" (R) areas.*	Subject Abbr.	Course No.*	Cr. Hours	Regular Regis.	Non-degree Regis.	Other or Transfer From +	
P	Automotive Control	ME		3			Other University	
P	Theory and Design of Control Systems	ME		3			Other University	
P	Digital Control	ME		3			Other University	
R	Mechanical Vibrations	ME		3			Other University	
R	Numerical Methods in Mechanical Engineering	ME		3			Other University	
R	Advanced Applied Mathematics I	Math		3			Other University	
R	Advanced Applied Mathematics II	Math		3			Other University	
P	Powertrain Integration	ME	50104	3				
P	Optimization Methods for systems and Control	ECE	58000	3				
P	Hybrid and Electric Transportation	ME	50105	3				
P	Introduction to Neural Networks	ECE	62900	3				
R	Finite Element Analysis	ME	55100	3				
R	Linear Algebra	Math	51100	3				
R	Optimal Design of Mechatronic Systems	ME	59700	3				

7. LANGUAGE REQUIREMENTS	Method to be used to meet language requirements
a.	a.
b.	b.

\+ Transfer course must be described as on original transcript.
* Mark course number with asterisk (*) if B or better is required.

8. NAMES OF ADVISORY COMMITTEE MEMBERS (Please type full name.)	9. GRADUATE FACULTY IDENTIFIER	APPROVED BY ADVISORY COMMITTEE MEMBERS (Signature)	10. DEPARTMENT Abbr.	10. DEPARTMENT Code	11. ADVISOR IN AREA OF:
Chair		Chair			

☐ Check here if supplemental notes or other requirements are attached.

13. APPROVED BY:

Head of the Graduate Program Date

12. SIGNATURE OF STUDENT Date

Academic Dean (if required) Date

Graduate School Dean

Submit original plus one copy to the Graduate School.

Comments, special notes, or other requirements:

GRADUATE SCHOOL

Request for PhD Degree Advisory Committee and Plan of Study Approval

(Please read instructions on reverse side.)

Pg. 1 of 1 Pgs. Date Degree Expected

1. NAME OF STUDENT XXX XXXX PUID No. /IUPUI

2. DEPARTMENT Mechanical and Energy Engineering Dept. Code MECH

Degree Title PhD Degree Code ME-PHD Research Area

3. AREA OF SPECIALIZATION (if any) Solid Mechanics, Biomechanics, Design AOS Code

Area	4. COURSES				5. METHOD OF ESTABLISHING CREDIT			6. DATE COMPLETED OR TO BE COMPLETED
	OFFICIAL TITLE ABBREVIATION *Please group courses into "Primary" (P) & "Related" (R) areas.*	Subject Abbr.	Course No.*	Cr. Hours	Regular Regis.	Non-degree Regis.	Other or Transfer From +	
P	Advanced Stress Analysis	ME		3			Other University	
P	Composite Materials	ME		3			Other University	
P	Advanced Dynamics	ME		3			Other University	
R	Mechanical Vibrations	ME		3			Other University	
R	Numerical Methods in Mechanical Engineering	ME		3			Other University	
R	Advanced Applied Mathematics I	Math		3			Other University	
R	Advanced Applied Mathematics II	Math		3			Other University	
P	Orthopedic Biomechanics	ME	59700	3				
P	Design Optimization Methods	ME	50601	3				
P	Mechanical Behavior of Materials	ME	56900	3				
P	Advanced Applications of Finite element	ME	65100	3				
R	Finite Element Analysis	ME	55100	3				
R	Linear Algebra	Math	51100	3				
R	CAD/CAM Theory and Applications	ME	54600	3				

7. LANGUAGE REQUIREMENTS	Method to be used to meet language requirements
a.	a.
b.	b.

\+ Transfer course must be described as on original transcript.
* Mark course number with asterisk (*) if B or better is required.

8. NAMES OF ADVISORY COMMITTEE MEMBERS (Please type full name.)	9. GRADUATE FACULTY IDENTIFIER	APPROVED BY ADVISORY COMMITTEE MEMBERS (Signature)	10. DEPARTMENT Abbr.	10. DEPARTMENT Code	11. ADVISOR IN AREA OF:
Chair		Chair			

☐ Check here if supplemental notes or other requirements are attached.

13. APPROVED BY:

Head of the Graduate Program Date

12. SIGNATURE OF STUDENT Date

Academic Dean (if required) Date

Graduate School Dean

Submit original plus one copy to the Graduate School.

Comments, special notes, or other requirements:

• ***Existing courses in the proposed curriculum***

The Department of MEE has offered 47 graduate level courses in the past five years. A list of the courses is shown in Table 5.

Table 5 Existing courses offered in the past five years

Course Number	Title	No. times taught in last five years	Frequency to be taught	Comments
ME 50000	Thermodynamics	4	1 per year	
ME 50101	Energy Assessment of Indu	3	1 per year	
ME 50102	Energy Management Princ	4	1 per year	permanent # available 2014F, previously offered under 59700
ME 50103	Industrial Energy Assessm	5	1 per year	permanent # available 2016F, previously offered under 59700
ME 50104	Powertrain Integration	1	Occasionally	
ME 50105	Hybrid and Electric Transp	2	Occasionally	permanent # available 2016S, previously offered under 59700
ME 50400	Automotive Control	4	1 per year	
ME 50500	Intermediate Heat Transfe	1	Occasionally	
ME 50900	Intermediate Fluid Mecha	5	1 per year	
ME 51000	Gas Dynamics	2	1 per year	
ME 52500	Combustion	4	1 per year	
ME 54200	Introduction to Renewable	4	1 per year	
ME 54600	CAD/CAM Theory and App	15	3 per year	
ME 55000	Advanced Stress Analysis	6	1 per year	
ME 55100	Finite Element Analysis	15	3 per year	
ME 55200	Advanced Application of F	1	Ocassionally	
ME 55800	Composite Materials	5	1 per year	
ME 56200	Advanced Dynamics	1	Ocassionally	
ME 56300	Mechanical Vibrations	4	1 per year	
ME 56500	Vehicle Dynamics	1	Ocassionally	
ME 56900	Mechanical Behavior of Ma	4	1 per year	
ME 58100	Numerical Methods in ME	5	1 per year	
ME 52301	Nanosystems Principles	5	1 per year	permanent # available 2017F, previously offered under 59700
ME 52601	Integrated Nanosystems P	5	1 per year	permanent # available 2017F, previously offered under 59700
ME 59700	Design Optimization Meth	5	1 per year	permanent # in process
ME 59700	Industry Energy Audit	10	2 per year	permanent # in process
ME 59700	Introduction to Systems Er	6	1 per year	permanent # in process
ME 59700	Systems and Speciality Eng	4	1 per year	permanent # in process
ME 59700	Energy Storage Devices an	4	1 per year	permanent # in process
ME 59700	Design of Mechanical Syste	2	1 per year	permanent # in process
ME 59700	Topology Optimization	3	1 per year	permanent # in process
ME 59700	Analysis and Design of Rob	3	1 per 2 years	permanent # in process
ME 59700	Additive Manufacturing	3	1 per year	permanent # in process
ME 59700	SysML Model Based Syster	2	1 per year	permanent # in process
ME 59700	Ceramic Materials for Rene	3	1 per 2 years	permanent # in process
ME 59700	Fuel Cell Science and Engi	2	1 per 2 years	permanent # in process
ME 59700	Flexible Electronics	1	1 per year	on schedule for spring 2018 permanent # will be requested
ME 59700	Design of Complex and Ori	1	1 per year	on schedule for spring 2018 permanent # will be requested
ME 59700	Kinetic Theory & Computa	1	1 per year	on schedule for spring 2018 permanent # will be requested
ME 59700	CAD/CAM II	1	1 per year	on schedule for spring 2018 permanent # will be requested
ME 59700	Iamge-based Engineering A	1	1 per year	on schedule for spring 2018 permanent # will be requested
ME 60101	Computational Modeling o	2	Ocaassionally	first offering as 59700
ME 61400	Computational Fluid Dynar	2	1 per 3 years	
ME 65100	Advanced Applications of I	3	1 per 2 years	
The following courses have only be taught once and are not currently scheduled for future classes				
Course Number	**Title**	**Offered**	**Coordinator**	
ME 59700	Orthopedic Biomechanics	1	Wagner	
ME 59700	Environmental Pollution a	1	Anwar	
ME 59700	Optimization and Desing o	1	Anwar	

The details of these courses are described in the departmental website, http://www.engr.iupui.edu/departments/me/courses/me/index.php.

The courses we have offered cover the primary courses required for each primary area, which is shown in the following table.

Thermal and Fluid	ME 50000 Thermodynamics
	ME 50500 Heat and Mass Transfer
	ME 50900 Intermediate Fluid Mechanics
	ME 51000 Gas Dynamics
	ME 52500 Combustion
	ME 55100 Finite Element Analysis
	ME 58200 Thermal Stress Analysis
	ME 61400 Computational Fluid Dynamics
	ME 65100 Advanced Applications of Finite Element Method
	ME 60101 Computational Modeling of Turbulence
Solid Mechanics, Biomechanics, Design	ME 50601 Design Optimization Methods
	ME 54600 CAD/CAM – Theory and Applications
	ME55000 Advanced Stress Analysis
	ME 55100 Finite Element Analysis
	ME 55800 Composite Materials
	ME 56000 Kinematics
	ME 56200 Advanced Dynamics
	ME 56300 Mechanical Vibrations
	ME 56900 Mechanical Behavior of Materials
	ME 59700 Topics: Orthopedic Biomechanics
	ME 60601 Optimal Design of Complex Mechanical Systems
	BME 60100 Principles of Biomedical Engineering I
	BME 60200 Principle of Biomedical Engineering II
	ME 65100 Advanced Applications of Finite Element Method
Mechatronics and Controls	ME 50104 Powertrain Integration
	ME 50105 Hybrid and Electric Transportation
	ME 50400 Automotive Control
	ME 52601 Integrated Nanosystems Processes and Devices
	ME 57500 Theory and Design of Control Systems
	ME 57800 Digital Control
	ME 58600 Microprocessors in Electromechanical Systems
	ME 57201 Analysis and Design of Robotic Manipulators
	ME 59700 Optimal Design of Mechatronic Systems: Robots
	ME 59700 Environmental Pollution and Emission Control
	ECE 53800 Digital Signal Processing
	ECE 55400 Electronic Instrumentation and Control Circuits
	ECE 58000 Optimization Methods for Systems and Control
	ECE 60200 Lumped System Theory
	ECE 62900 Introduction to Neural Networks
	ECE 68000 Modern Automatic Control
	ECE 68500 Introduction to Robust Control
	CSCI 54900 Intelligent Systems
	CSCI 55600 Fault Tolerant Computing
Energy and Materials	ME 50000 Thermodynamics
	ME 50101 Energy Assessment of Industrial Processes
	ME 50102 Energy Management Principles
	ME 50103 Industrial Energy Assessment: Tools and
	ME 50500 Heat and Mass Transfer
	ME 50900 Intermediate Fluid Mechanics
	ME 51200 Energy Storage Devices and Systems
	ME 52301 Nanosystems Principles
	ME 52500 Combustion
	ME 54200 Introduction to Renewable Energy
	ME 54800 Fuel Cell Science & Engineering
	ME 55000 Advanced Stress Analysis
	ME 55100 Finite Element Analysis
	ME 55800 Composite Materials
	ME 56802 Ceramics Material for Renewable Energy
	ME 56900 Mechanical Behavior of Materials
	ME 59700 Electrochemistry for Engineering
	ME 59700 Introduction to Tribology
	ME 59700 Micromechanics of Materials
	ME 69700 Computational Fracture Mechanics

• ***Courses to be added***

None

Appendix A.2

School of Engineering and Technology

Indiana University-Purdue University Indianapolis (IUPUI)

DEPARTMENT OF MECHANICAL AND ENERGY ENGINEERING

Ph.D. Program Handbook

IUPUI

DEPARTMENT OF MECHANICAL
AND ENERGY ENGINEERING

SCHOOL OF ENGINEERING AND TECHNOLOGY

Indiana University–Purdue University
Indianapolis

TABLE OF CONTENTS

1. INTRODUCTION

Overview

The Department of Mechanical and Energy Engineering (MEE) welcomes you to IUPUI and the ME graduate program. We expect your time here to be an experience of enriched learning, exploration and discovery, and professional & personal growth. We hope that this will be an invigorating experience which fosters a lifetime of learning.

This manual is intended to answer common questions Ph.D. students have concerning their program of study, Graduate School operations, the graduate program in Mechanical Engineering, and services provided by the Purdue School of Engineering and Technology (ET) Graduate Office. It provides information on registration procedures, Plan of Study (POS) preparation procedures, acceptable scholastic performance, dissertation preparation, and various requirements that must be met to receive a Ph.D. degree.

Special situations certainly may arise which are not addressed here. We welcome the opportunity to discuss these issues with you. Timing is often an important factor, and an early visit to the Graduate Academic Advisor can save much effort and time for students and faculty alike. In particular, Ph.D. students must comply with requirements of the Department of MEE set forth in this handbook.

This handbook describes the requirements and regulations for the Ph.D. degree programs in the Department of Mechanical and Energy Engineering (SL Building, Rm. 260). The guidelines and procedures set forth in this handbook will help you in preparing your POS (see Section 2) and in meeting the necessary degree requirements for completing the program and graduation. We invite you to visit the Chair of the Graduate Education and Research Committee (GERC) and academic advisor in the Department of Mechanical and Engergy Engineering (SL 260) with questions related to graduate studies or any other academic matters. In addition, you are required to subscribe to the MEE Canvas "GRAD_Site" to stay informed on program matters, to participate in the discussions of graduate study related topics and issues, and to receive information on job opportunities. Important announcements are also posted on the bulletin board outside the MEE Office (SL 260).

Handbook

This handbook is aimed at the Ph.D. program at IUPUI. Specific requirements for the Ph.D. program are described in section 2. Administration of the Ph.D. program is handled by the MEE Department (SL 260; http://www.engr.iupui.edu/departments/me/); Purdue University Graduate School (West Lafayette campus; https://engineering.purdue.edu/ME/Academics/Graduate/index.html), and the IUPUI Graduate Office (University Library, Room 1170; http://www.iupui.edu/~gradoff/). You should become familiar with their roles and procedures. In addition, if you are an international student, you will have contacts with the Office of International Affairs (OIA) at IUPUI (Education and Social Work Building, ES Rm. 2126) regarding visas and immigration regulations. The MEE Graduate Advisors (SL 260) can direct you to the appropriate office for

specific issues.

2. NEW STUDENT INFORMATION

Student ID: Each admitted student at IUPUI is given a student identification number. Use that number to establish a student account. The one.iu.edu will let you access your university academic record, financial information, personal information, campus life and general information.

Communication: E-mail and Canvas are the primary modes of communication used between the Graduate Programs office and all graduate engineering students. Be sure that the Graduate Programs Office always has your current and active email address on file.

Course Selection: One of the first questions to address, as a new student, is how to be properly registered for graduate classes. This process may begin as soon as you have received the official notification of admission from the Purdue Graduate School. To be prepared for registration you should:

Have information about the program, its requirements, and the courses, along with this Graduate Program Handbook, you should also refer to the following:

Schedule of Classes: Course offerings and a schedule of classes are available online at this website**:** http://registrar.iupui.edu/schedule.html.

Faculty Research Expertise: This website provides a list of faculty members with their respective research interests: http://et.engr.iupui.edu/departments/me/people/index.php. Copies of these materials can also be obtained from either the MEE department in SL260 or the School of Engineering and Technology Graduate Programs Office in ET 215.

All Ph.D. students are assigned a Major Professor when they are admitted to the ME Graduate program. Immediate consultation with the Major Professor is required for all new students. The purpose of the consultation is to begin planning your doctoral program and to decide which courses you should take your first semester. The Major Professor will serve as the chair of the student's advisory committee (see Section 2).

After consulting with the Major Professor, prepare a tentative list of classes for the initial semester according to the web-based *"Course Offerings"* and *"Schedule of Classes"* for that particular semester. Online course offerings and the schedule of classes can be accessed through the Office of the Registrar website at registrar.iupui.edu. When you have your class schedule prepared and are ready to register, register directly via the web- based student information system, *one.iu.edu*.

Registration: Registration and fee information is available on the one.iu.edu web site. The Bursar's computer system will schedule and print the registration statement and the fee statement for mailing to the student.

Late Registration Fees: Students completing their registration after the first week of class are automatically assessed a late fee by the Bursar. Questions or problems regarding the registration

process should be directed to the MEE Graduate Office.

Registration for subsequent semesters:

Students are required to meet with their Major Professor to discuss a tentative plan of study before the end of the first semester to choose courses for registration.

Registration for summer and fall semesters begins approximately the second week in March. Registration for the spring semester begins approximately the second week of October. Students should complete the registration procedure as follows:

- Access the Schedule of Classes at (http://one.iu.edu. (See Introduction)
- Meet with the Major Professor to select courses.
- Meet with the graduate advisor to begin completion of the registration form
- Obtain the signature of the Major Professor for approval.
- If a TA or an RA has been awarded, meet with the MEE department secretary for completion of paper work.
- Submit the registration form and tuition waiver form, if applicable, to the MEE Graduate Office.
- Register online or in person with the registrar.

Additional Registration Guidelines for Employed Students

Students who have research assistantships or teaching assistantships should always meet with the MEE administrative assistant in SL260 before completing the final step for registration (Section 3). Completion of this step each semester will ensure that proper documentation exists for the prompt payment of the stipend and, when appropriate, for payment of tuition.

Students seldom register for more than nine credits of coursework in a single semester. Students who have graduate assistantships, including teaching assistantships, research assistantships, and university fellowships, in the Department of Mechanical and Energy Engineering are required to register for a minimum of six credits during the fall and the spring semesters. Requests for exceptions to the requirement must be submitted to the GERC Chair and are reviewed on a case-by-case basis.

3. PHD DEGREE PROGRAMS IN MECHANICAL ENGINEERING

The department's Ph.D. program consists of two types of Ph.D. applicants, Direct Ph.D. (DPh.D.) students who have received a baccalaureate degree in mechanical engineering or related engineering programs and Ph.D. students who already have master's degrees. All students must have earned at least a baccalaureate degree from a U.S.-accredited institution or an equivalent degree from a foreign institution. The requirements for the two types of students are different. Students should know the requirements that apply to them.

Admission

Ph.D. Degree Program

Qualifications

Students with an M.S. in Mechanical Engineering or related engineering at the time of admission may be admitted to the Ph.D. program at IUPUI. The student must have a cumulative GPA ≥ 3.20 for the Master's degree from a reputable university. The student also must have taken the GRE and received good scores. The Graduate Committee approves Ph.D. applications.

Direct Ph.D. (DPh.D.) Degree Program

Qualifications

Students with strong performance in coursework and some research experience at the undergraduate level may be admitted into the DPh.D. program at the time of admission to graduate studies at Purdue. The student must have a GPA ≥ 3.50 in the baccalaureate degree from a highly ranked university. The student also must have taken the GRE with minimum scores of 150 in verbal, 161 in quantitative and 3.5 in analytical. The Graduate Committee approves DPh.D. applications.

A graduate student who enters the Master's program but later wants to pursue the DPh.D. may submit a request to the Graduate Chair for approval by the Graduate Committee. The student must have an undergraduate GPA ≥ 3.2, must have completed at least 12 credit hours of graduate coursework with a minimum GPA of 3.75 and must have minimum GRE scores of 150 in verbal, 161 in quantitative and 3.5 in analytical. The request also must include a written endorsement by the Major Professor. The request must be submitted to the Graduate Chair before the first semester after the student has completed at least twelve credit hours of graduate coursework.

Primary Area of Specialty and Related Area Courses

There are primary areas of specialty and related areas in each Ph.D. student's POS. The four primary areas in our Ph.D. program are:

- Solid Mechanics, Biomechanics, and Design
- Energy and Materials

- Fluid and thermal sciences
- Mechatronics and controls

Courses are classified under either primary area or related area. Those courses directly related to the area of specialty are classified as primary and those courses outside of the specialty area are classified as related course. This list may periodically change: the Graduate Committee will have updated information.

Curriculum

Primary Area Courses

Primary Area: Solid Mechanics, Biomechanics, and Design

ME 50601 Design Optimization Methods

ME 54600 CAD/CAM – Theory and Applications

ME 55000 Advanced Stress Analysis

ME 55100 Finite Element Analysis

ME 55700 Design for Manufacturability

ME 55800 Composite Materials

ME 56000 Kinematics

ME 56200 Advanced Dynamics

ME 56300 Mechanical Vibrations

ME 56900 Mechanical Behavior of Materials

ME 58100 Numerical Methods in Mechanical Engineering

ME 58200 Thermal Stress Analysis

ME 59700 Topics: Orthopedic Biomechanics

ME 59700 Topics: Topology Optimization

ME 60601 Optimal Design of Complex Mechanical Systems

ME 59700 / BME 59500 Skeletal Biomechanics

BME 60100 Principles of Biomedical Engineering I

BME 60200 Principles of Biomedical Engineering II

ME 65100 Advanced Applications of Finite Element Method

Primary area: Energy and Materials:

ME 50000 Thermodynamics

ME 50101 Energy Assessment of Industrial Processes

ME 50102 Energy Management Principles

ME 50103 Industrial Energy Assessment: Tools and Applications

ME 50500 Heat and Mass Transfer

ME 50900 Intermediate Fluid Mechanics

ME 51200 Energy Storage Devices and Systems

ME 52301 Nanosystems Principles

ME 52500 Combustion

ME 54200 Introduction to Renewable Energy

ME 54800 Fuel Cell Science & Engineering

ME 55000 Advanced Stress Analysis

ME 55100 Finite Element Analysis

ME 55800 Composite Materials

ME 56802 Ceramics Material for Renewable Energy

ME 56900 Mechanical Behavior of Materials

ME 59700 Electrochemistry for Engineering

ME 59700 Introduction to Tribology

ME 59700 Micromechanics of Materials

ME 69700 Computational Fracture Mechanics

Primary area: Fluid and Thermal Sciences

ME 50000 Thermodynamics

ME 50500 Heat and Mass Transfer

ME 50601 Design Optimization Methods

ME 50900 Intermediate Fluid Mechanics

ME 51000 Gas Dynamics

ME 52500 Combustion

ME 55100 Finite Element Analysis

ME 58100 Numerical Methods in Mechanical Engineering

ME 58200 Thermal Stress Analysis

ME 59700 Topics: Principles of Turbo-machinery

ME 59700 Topics: Introduction to Tribology

ME 61400 Computational Fluid Dynamics

Primary area: Mechatronics and Controls

ME 50104 Powertrain Integration

ME 50105 Hybrid and Electric Transportation

ME 50400 Automotive Control

ME 52601 Integrated Nanosystems Processes and Devices

ME 54600 CAD/CAM Theory and Applications

ME 55100 Finite Element Analysis

ME 56300 Mechanical Vibrations

ME 56500 Vehicle Dynamics

ME 57500 Theory and Design of Control Systems

ME 57800 Digital Control

ME 58100 Numerical Methods in Mechanical Engineering

ME 57201 Analysis and Design of Robotic Manipulators

ME 59700 Optimal Design of Mechatronic Systems: Robots and Interactive Structures

ME 59700 Environmental Pollution and Emission Control

ECE 53800 Digital Signal Processing

ECE 55400 Electronic Instrumentation and Control Circuits

ECE 58000 Optimization Methods for Systems and Control

ECE 60200 Lumped System Theory

ECE 62900 Introduction to Neural Networks

ECE 68000 Modern Automatic Control

ECE 68500 Introduction to Robust Control

CSCI 54900 Intelligent Systems

CSCI 55600 Fault Tolerant Computing

Mathematics Courses

Nine (9) credit hours of mathematics courses are required in the plan of study (including M.S. coursework). This requirement may be met by taking any of the two acceptable three-credit hour courses from the mathematics department (see the list below) and an equivalent course with a strong math content from another department, including ME.

The following are acceptable mathematics courses offered by the Math Department:

MATH 53700 Applied Mathematics for Scientists and Engineers I

MATH 52800 Advanced Mathematics for Engineering and Physics II

MATH 51000 Vector Calculus

MATH 51100 Linear Algebra with Applications

MATH 52300 Introduction to Partial Differential Equations

MATH 57800 Mathematical Modeling of Physical Systems

The following courses are acceptable equivalent courses offered by the MEE Department

ME 55100 Finite Element Analysis

ME 58100 Numerical Methods in Mechanical Engineering

ME 61400 Computational Fluid Dynamics

Graduate Seminar

All Ph.D. students must enroll in a zero credit hour seminar course for two semesters during their residency.

ME 59800 Topics: ME Seminar

Area Examination Rules and Areas

Before a student becomes an official candidate for the Ph.D. degree, the Area Examinations and Preliminary Examinations must be passed. Ph.D. students pursuing their studies at IUPUI must take the Area Examinations subject to the same conditions stated in this handbook. Depending on the registration of an area exam, that exam will be held at IUPUI. If an area has no student registration, no exam will be held in that area.

Responsibility and Authority: The responsibility and authority for the implementation of the Ph.D. Area Examinations rests with the Mechanical Engineering faculty at IUPUI. Certain portions of this responsibility and associated authority are delegated to the GERC, IUPUI, and/or the student's Advisory Committee.

Purpose: The Ph.D. Area Examinations exist to provide assurance that all Ph.D. candidates have sufficient knowledge of fundamental principles in selected areas of Mechanical Engineering. Accordingly, these procedures apply to all Ph.D. students, including those who do not have B.S. and/or M.S. degrees in Engineering.

Area Examinations: The student is expected to demonstrate a firm command of fundamental principles up to and including the Master's level in applied mathematics plus at least two of the following approved areas of Mechanical Engineering: (1) control, (2) design, (3) dynamics, (4) fluid mechanics, (5) heat and mass transfer, (6) solid mechanics, (7) thermodynamics, and (8) materials.

Written examinations in these nine areas will be offered each semester, excluding the summer session. The student must take all three Area Examinations when taking the exams in the first attempt and no later than the second semester of residency past receipt of the Master's degree. A request by the student for exception to these constraints must be submitted in writing to the Advisory Committee and should clearly indicate the unusual and/or special circumstances justifying the request. If the student's Advisory Committee approves, the approved request must be transmitted to the Chair of the GERC in time for appropriate action. Such a request will require approval by the GERC in addition to the student's Advisory Committee.

The Area Examination Committee at IUPUI will prepare, administer and grade the Area Examinations, and then report the results to both the Major Professor and the GERC at IUPUI. The Area Examination Committee will give grades of pass, fail, or conditional pass. The grade of "pass" will require no remedial action on the part of the student. The grade of "conditional pass" will be associated with a recommendation for remedial work but not re-examination. Since these written examinations are meant to guide the student's Advisory Committee, any areas of weakness indicating a need for remedial work should receive

immediate action. The remedial work specified by the student's Advisory Committee, either coursework or individual study or both, should be reported in writing to the Chair of the GERC with signatures from all members of the Advisory Committee.

Ph.D. students will be given two chances to pass the Area Examinations and must be enrolled in thesis hours in the semester they take their exams. A student who is unable to pass all the required Area Examinations after two attempts will be dismissed from the Ph.D. program. If desired by the student and the Major Professor, the student may make a request to the Graduate Committee to change from the Ph.D. to the Master's degree program.

Each semester, the GERC will report to the Mechanical Engineering faculty on student performance and actions taken by the various Advisory Committees concerning the Area Examinations.

Ph.D. Program Advisory Committee

Each Ph.D. student needs to have a Major Professor and an Advisory Committee. The Advisory Committee consists of at least four members and must be chaired by one MEE faculty member from IUPUI. The chair serves as the Major Professor who guides the student's dissertation research. At least two members of the Advisory Committee (including the chair) must be MEE faculty. One committee member must be from a department/school outside of MEE.

An outside member can be someone with a Ph.D. who is in industry. All professors serving on an Advisory Committee must already be regular or special graduate faculty (i.e., certified by the Graduate School to serve on the committees of graduate students). Also eligible to serve on an Advisory Committee are faculty members from other universities, scientists at national labs, or researchers in industry. These members require prior approval from the Graduate School in the form of a certification as special graduate faculty. In case a student and the Major Professor contemplate including such a member in the Advisory Committee, the Chair should send to the Chair of GERC a letter requesting this person's inclusion along with a clear justification of the specific expertise that the requested member will bring to the research to be conducted by the student. An electronic version of the complete vita of the Advisory Committee nominee must be provided with this memo. This request must be submitted in one transaction. Do not ask the outside person to submit information directly to the GERC Chair. This should be done by the Major Professor.

Plan of Study (POS)

Each Ph.D. student must file a POS by the end of the 1st semester after the student has a Major Professor and has established an Advisory Committee. Students failing to meet this requirement will not be permitted to complete their registration for the next semester. All courses included on the POS for an ME degree must be "technical and quantitative in content."

The POS must be created in the *Purdue Graduate Database* by selecting *Graduate Student Database* under *Academic*. The instructions are on *MyPurdue.Purdue.edu* Students may create and save a draft POS and return later to complete it. The POS address cannot be bookmarked. Important: the draft POS must be submitted as a "final" to be approved. Keep in mind that the

POS must be approved before the second semester of their degree program.

The POS may be modified after it is filed. The draft POS must be submitted to the Major Professor, and, after approval, the Graduate Coordinator will assist the student in preparing the final copy and submitting it for approval.

A POS consists of a group of courses in the student's "Primary Area" and other courses in "Related Areas." Courses on the POS must have quantitative and technical content. Courses in the primary area should show a reasonably close relation to the core subject. For example, if your primary area is heat transfer, it might include courses in heat transfer, mass transfer, fluid mechanics, and thermodynamics. Courses in the primary area can also come from schools or departments other than Mechanical and Energy Engineering. Courses in related areas are outside your primary area but still contribute to your program. These courses may come from MEE or from other schools or departments.

When completing the POS, students should choose from the following list for the Area of Specialization:

1. Thermal and Fluid Sciences
2. Solid Mechanics, Biomechanics, and Design
3. Mechatronics and Controls
4. Energy and Materials

After Graduate School approval, the courses listed on the POS must be completed before certification for graduation can be granted.

Changes to the approved POS require approval of the Advisory Committee. This process may be used to change Advisory Committee members, to delete or add courses, or to change the area of specialization. Courses may not be removed from the POS after a grade has been received.

4. SPECIFIC REQUIREMENTS FOR Ph.D. STUDENTS WITH M.S. DEGREE

Essential Actions for Completion of the Ph.D.

First Year

- Meet with your Major Professor to discuss course selection before registering.
- Complete the registration process in the ET Graduate Office. Students with foreign language requirement using Option D should register for a foreign language course.
- Thoroughly review the Ph.D. section of the IUPUI Mechanical Engineering Graduate Procedures Manual (latest update). Locate this manual at http://www.engr.iupui.edu/departments/me/grad/doctor-of-philosophy-in-mechanical-engineering.php

- Choose your Advisory Committee.

- Register for and successfully complete the Area Examinations before the end of the second semester of residence in the Ph.D. Program. A request by the student for an exception to these requirements may be submitted in writing to the student's Advisory Committee and should clearly indicate the unusual and/or special circumstances justifying the request. If the student's Advisory Committee approves, the request must then be transmitted to the Graduate Chair in time for appropriate action. The request requires approval by the Graduate Committee in addition to the student's Advisory Committee.

- Formalize a POS in consultation with your Major Professor(s). The POS should be submitted at the end of the first semester.

- Complete the foreign language requirement, if necessary.

First year after passing the area exams

- Take Preliminary Exams (enrolled in Ph.D. thesis hour).

Final Semester

- Indicate your intention to graduate on your registration form to declare candidacy.

- Submit a Change to the Plan of Study form to the MEE GERC no later than the beginning of the final semester of graduate study, if needed.

- Obtain a Candidate Packet with a list of deadlines for students from the ET Graduate Office.

- Schedule the dissertation defense two weeks prior to the deadline for the defense.

- Submit the first draft of your dissertation to your Major Professor well before the date of your defense.

- Submit the MEE Departmental Check-out Signature Form to the Graduate Office before leaving campus. Include a forwarding address when the form is submitted.

Ph.D. Coursework

Ph.D. coursework requires a minimum of 21 graduate credit hours beyond the Master's degree. A minimum of 90 graduate course and research credit hours (including at most 30 credit hours from an M.S. degree) is required for graduation. All Plans of Study must contain at least two semesters of ME 59800 MEE Graduate Seminar (IUPUI Ph.D. students are required to take ME59800 every semester when they receive financial aid.) and a minimum of nine hours of applied mathematics. At least six of these hours must be taken from the Mathematics Department. A minimum of one course (3 credit hours) must be at 6XXXX level. (These requirements may be partially or fully satisfied by courses taken as a part of the M.S. program.)

5. SPECIFIC REQUIREMENTS FOR DPh.D STUDENTS

Essential Actions for Completion of the DPh.D

First Year

- Meet with your Major Professor to discuss course selection before registering.
- Complete the registration process in the ET Graduate Office. Students with foreign language requirement using Option D should register for a foreign language course.
- Thoroughly review the DPh.D. section of the IUPUI Mechanical Engineering Graduate Procedures Manual (latest update). Locate this manual at http://www.engr.iupui.edu/departments/me/grad/doctor-of-philosophy-in-mechanical-engineering.php
- Choose your Advisory Committee.
- Register for and successfully complete the Area Examinations before the end of the fourth semester of residence in the DPh.D. Program. A request by the student for an exception to these requirements may be submitted in writing to the student's Advisory Committee and should clearly indicate the unusual and/or special circumstances justifying the request. If the student's Advisory Committee approves, the request must then be transmitted to the Graduate Chair in time for appropriate action. The request requires approval by the Graduate Committee in addition to the student's Advisory Committee.
- A student who changes to the DPh.D. program after initial admission to Master's degree will be notified in the change approval letter as to when the Area Examinations must be attempted. Generally this will be the second semester the student has Ph.D. status.
- Formalize a POS in consultation with your Major Professor(s). The POS should be submitted at the end of the first semester.
- Complete the foreign language requirement, if necessary.

First year after passing the area exams

- Take Preliminary Exams (enrolled in Ph.D. thesis hour).

Final Semester

- Indicate your intention to graduate on your registration form to declare candidacy.
- Submit a Change to the Plan of Study form to the MEE GERC no later than the beginning of the final semester of graduate study, if needed.
- Obtain a Candidate Packet with a list of deadlines from the ET Graduate Office.

- Schedule the dissertation defense two weeks prior to the deadline for the defense.

- Submit the first draft of your dissertation to your Major Professor well before the date of your defense.

- Submit the MEE Departmental Check-out Signature Form to the Graduate Office before leaving campus. Include a forwarding address when the form is submitted.

DPh.D. Coursework

- A DPh.D. POS includes a minimum of 36 credit hours of coursework in addition to thesis research credit hours.

- Only graduate level courses (50000 or 60000 numbers) may be listed on a DPh.D. POS. At least one of the courses must be at the 60000 level. Independent project courses (ME 59700 or ME 69700) are limited to a maximum of three credit hours.

- At least six of these hours must be taken from the Mathematics Department. A minimum of one course (3 credit hours) must be at 6XXXX level.

- All DPh.D. POS must contain a minimum of nine credit hours of applied mathematics, at least six of which must be taken from the Department of Mathematics.

- Two semesters of successful completion of ME 59800: MEE Graduate Seminar are required. This course is not listed on the POS.

- You and your Major Professor may decide that additional courses not included on the POS should be taken to strengthen your background in a particular area.

- Courses taken to satisfy a condition of a Ph.D. Area Exam cannot be used toward the minimum POS coursework requirement for the degree. However, the courses may be included on the POS provided there is a supplemental note explaining that the courses have been used to meet a condition of a Ph.D. Area Exam.

Optional Master's Degree Along the Way

- Students enrolled in the DPh.D. program have the option of seeking a Master's degree "along the way" to the Ph.D.. This option is available when the student meets the Master's degree requirements for ME and the Graduate School. The student must submit a written request endorsed by the Major Professor to the Graduate Chair. Upon approval, the student will file a Master's POS and will register for Master's candidacy that semester. The Master's plan can be for a non-thesis option and must satisfy ME's requirements for a non-thesis Master's degree.

Scholastic Requirements

- Requirements for completing the Ph.D. or DPh.D. degree are:

- Successfully complete all courses on your approved Plan of Study.

- Pass the Area Examinations and Oral Preliminary Examination as specified by your Advisory Committee (Section 3).

- Complete the dissertation to the satisfaction of your Final Examining Committee.

- Accumulate ninety (90) credits in coursework and research (See below).

- Earn grades of A or B as expected from Ph.D. or DPh.D. students. An occasional "C" in a 60000 level course or in a related area course will be acceptable, but the large majority of your courses must show A or B grades. Pass/Fail grades are not acceptable in fulfilling degree requirements.

- Accrue a minimum of thirty credits earned by continuous residence at IUPUI. In fulfilling the course requirements, a maximum of fifteen credit hours will be allowed from any one semester and a maximum of eight credits from a summer session.

- Maintain a 3.0/4.0 grade point average index on the POS. Semester Grade Reviews are conducted by the GERC each semester. Warning letters are sent to those Ph.D. or DPh.D. students either not maintaining a minimum 3.0 or failing to make successful progress in their research. The Plan of Study index for Ph.D. or DPh.D. students is based on courses taken at IUPUI that apply toward the Ph.D. or DPh.D. and have not been previously applied towards the Master's degree. The warning letter may set forth specific conditions to be met within a specified period.

- Complete satisfactory coursework and research. Unsatisfactory coursework and/or research, if continued, may lead to dismissal from the Mechanical Engineering graduate program. **A student whose POS index is below 2.85 after twelve semester hours of coursework will be dropped automatically from the program.** Should the student's Advisory Committee advise the GERC of unsatisfactory performance on research, the student may be considered for dismissal at the end of any semester.

6. AREA EXAMINATIONS: REGISTRATION AND ADMINISTRATION

Registration

Early in the semester, the Graduate Office will announce registration for the Area Examinations. Students obtain the registration form from the MEE Office and return it by the deadline date: It must include a list of at least three tentative Advisory Committee members and the signature of the Major Professor. Area Examinations usually are held during the fourth and fifth weeks of the semester. Each registered student will be given a schedule of the exams and is expected to appear in the room listed for that exam on the day and time scheduled. Each student must take the Math Exam during the first sitting for the Area Examinations along with two other exams.

Grading and Reporting Exam Scores

Area Exam Committee Input: The respective Area Exam Committee will evaluate the student's performance in each Area Examination. Each Area Exam Committee Chair will report results for each student to both the Major Professor and GERC on a pass/fail/conditional-pass basis. Satisfying the requirements means that the students passes the exam. A "conditional pass" determined by the Area Exam Committee will provide requirements for remedial action. Failing to satisfy the requirements means that the student fails the exam.

Advisory Committee Input

The Major Professor of the student, in consultation with the Advisory Committee, will provide to the GERC a written evaluation of the student's performance to date. The evaluation includes coursework, various components associated with research potential and progress of the student (interactions with group members, scientific contributions, development of experimental skills, theoretical developments, etc.), and the Major Professor's intention to retain and financially support (given resource availability) the student for further Ph.D. studies in ME. The Advisory Committee has the option to include additional information deemed relevant to Graduate Committee deliberations.

The GERC will evaluate the student's overall performance in all three Area Examinations and the evaluation of the Advisory Committee. The results of this evaluation will be one of the following:

Pass: The student who clearly passes the three Area Examinations and has satisfactory input from the Advisory Committee typically is allowed to continue in the Ph.D. program and prepare the Ph.D. proposal for the Preliminary Examination.

Fail: A student not passing one (or more) of the Area Examinations on the first attempt may be allowed to retake it/them at the next offering of the failed examination(s). When retaking the exam(s), the student may choose to take an exam in a different area (if not applied math); however, only one attempt will be allowed in this different area. Alternatively, the Graduate Committee may advise the student after the first failed attempt to transfer to the Master's program. A student who fails a retake of an exam will be dismissed from the graduate program.

Conditional Pass: A student with lower than acceptable performance in an Area Examination may be required to remedy the deficiencies by taking an appropriate course. The course may be at the graduate level or at the undergraduate level. The minimum performance expectations will be specified.

The student and Major Professor will be notified via a letter from the Chairman of the GRC regarding the final assessment of each section of the Area Examination (pass/fail/conditional pass) as well as an overall exam designation. Students who do not pass an exam are encouraged to discuss their performance with the Major Professor as well as the appropriate Area Exam chairs.

Unsatisfactory Area Exam Results

A student has only two attempts to pass an Area Exam, subject to the process described above. The student who fails an Area Exam and is granted a second attempt must retake that

examination the following semester. A student will be dismissed by the Graduate Committee from the graduate program if any Area Examination is failed twice.

A dismissal appeal may be made as a written petition to the GERC by the student with a supporting letter from the student's Major Professor and Advisory Committee. The petition must explain the reasons the student should be allowed to continue in the Ph.D. degree program. If the petition is denied, the student, the Major Professor and the Advisory Committee may then appeal to the MEE faculty.

A student in the DPh.D. or Ph.D. program who fails to pass all area exams may petition the GERC Chair to change from the Ph.D. or DPh.D. to the Master's program. After completing the Master's degree, the student can apply to the Ph.D. program. If accepted, the student will have to start over with Area Examinations.

Each semester, the Graduate Committee will review all students' performance and actions taken by the various Advisory Committees and the Graduate Committee concerning the Area Examinations.

7. PRELIMINARY AND FINAL EXAMINATIONS

Oral Preliminary Examinations

The Oral Preliminary Examination should be completed within one year after successful completion of the Area Examinations. The responsibility and authority for the Ph.D. Oral Preliminary Examination rests entirely with the student's Advisory Committee. The Oral Preliminary Examination exists to provide assurance that all Ph.D. candidates have in-depth knowledge of subject matter closely related to the student's research topic. In the Oral Preliminary Examination, the student should:

- Demonstrate fundamental competency in areas that required remedial action per the Area Examinations.

- Demonstrate in-depth knowledge of subject matter related to the thesis topic.

- Present a written research proposal containing a reasonable research plan for the dissertation. The Purdue Graduate School must receive the formal request for an appointment of the Preliminary Examination Committee at least two weeks prior to the date of the Preliminary Exam. Form 8 is available both on the Graduate School web page under Publications, Forms and Reports and in the MEE Office.

Final Examination

At least two terms must elapse and be devoted to research between the Preliminary and Final Examinations. The Final Examining Committee consists of a minimum of four members and is appointed at the request of the student's Major Professor. The same guidelines (Section 7) for choosing the Advisory Committee apply. The Examining Committee is normally the same as the student's Advisory Committee and is responsible for reading the student's dissertation and conducting the Final Examination. A copy of the dissertation should be submitted to the

Examining Committee and the Graduate Chairman at least two weeks before the examination (see Section 13- E, F). Final Oral Exam Presentations are open to all interested parties. Therefore, the WL Graduate School requires that the date, time and room for the examination be registered at least two weeks in advance via Form 8: Room location needs to accommodate at least 20 people. At the time the exam is scheduled, the student will send an electronic copy of the abstract to the MEE GERC Chair for distribution to the MEE faculty and graduate students.

Final Exam Registration, Dissertation Approval and Dissertation Deposit

A Manual for the Preparation of Graduate Dissertation is available in the ET Graduate Office and on the Graduate School web page. IMPORTANT NOTE: Type "Department of Mechanical and Energy Engineering, Indianapolis" at the beginning of the abstract, after the name(s) of the Major Professor(s). Express appreciation for any financial support in the "Acknowledgments" section.

AT LEAST TWO WEEKS BEFORE THE PH.D. FINAL EXAMINATION DATE, submit Form 8 to the MEE Graduate Office – Request for Appointment of Examining Committee, which registers the date, time and location of the defense. Form 8 is available on the Graduate School website under Publications, Forms, and Reports.

When the exam registration (Form 8) is approved by the Graduate School at WL, it will be returned to the MEE Graduate Office with an additional form:

Graduate School Form 9 – Dissertation Acceptance (Signature) Page. Obtain Form 9 from the MEE Graduate Office with a copy of the examination registration approval from the Graduate School. Bind the original Form 9/Signature page into the Library Thesis Office Deposit Copy and bind copies of the form in the dissertation copies (see H 1-3 below).

On Form 9: Type the names of individual examining committee members under the appropriate signature lines on the dissertation signature page. Type "School of Mechanical Engineering" under the line for the Department Head signature on the thesis signature page.

If a thesis is to be classified as "confidential," obtain Form 15 – Request for Confidentiality of Thesis from the ET Graduate Office. Complete this formand submit it to the Graduate Chairman at the same time as the dissertation for final approval.

Consult your Major Professor if the confidentiality of the dissertation is uncertain.

NO LATER THAN TWO WEEKS BEFORE THE FINAL EXAMINATION, submit an electronic copy of the dissertation to the MEE Office for format approval. This submission should be as far ahead of the deadline as possible but cannot be made any later than two weeks prior to the final examination.

NO LATER THAN TWO WEEKS BEFORE THE FINAL EXAMINATION, submit a copy of the dissertation to the Examining Committee.

After the Final Examination, revise the dissertation according to the requirements of the

Examining Committee and the format review.

Submit the revised dissertation to the MEE GERC for final approval to the Graduate Chair. The Graduate Chair will require three days minimum to read the dissertation and may require additional changes before final approval. After final approval has been granted, an electronic copy will be filed and stored at IUPUI and WL. Bound copies are no longer required.

If no additional corrections are required and final approval is given, deposit the dissertation copies as follows:

The MEE Graduate Office will retain the MEE Departmental Copy for electronic deposit. (If the thesis has been classified as "confidential," submit an abstract to the MEE Graduate Office.)

An electronic copy of theses classified as "confidential" is retained by the Thesis and Dissertation Deposit and Approval Office.

Publication: It is expected that Ph.D. dissertation research will lead to journal publication(s). It is recommended that the Ph.D. candidate prepare at least two (2) manuscripts for scholarly journal papers before the final examination.

Dismissals:

The GERC action regarding dismissals from the Mechanical Engineering graduate program that have resulted from failure to meet the index requirements will take place as soon as practical after grade reports are received following the end of an academic term. The GERC determines the effective date of dismissal. Normally the official date of dismissal will be approximately three weeks after the decision, but in some cases, it may be extended until the end of the term. Course registration will not be allowed after dismissal takes effect, and registration for the current term will be canceled if classes have already begun. It is understood that dismissal from the graduate program implies termination of any assistantship held by the student in the Department of Mechanical and Energy Engineering.

Appeal Process: If a student's Advisory Committee feels that special circumstances are involved, it may appeal a dismissal by making a written petition to the GERC. A student whose Advisory Committee does not support an appeal may petition the GERC directly. An appeal will be successful only if evidence is presented to show that unusual circumstances were responsible for the student's poor performance and a reasonable chance exists for the student to complete the program successfully.

8. TIME LIMIT FOR Ph.D. OR DPh.D. PROGRAMS

Graduate study, particularly at the Ph.D. level, is less structured than undergraduate study, and the time needed for a particular student to complete a program depends on many factors. Nevertheless, a student who is actively pursuing a degree should be able to complete the coursework and dissertation in a reasonable length of time beyond which the relevance and originality of his work becomes suspect. Accordingly, the Department. Of Mechanical and

Energy Engineering has adopted the following policy used by the School of Mechanical Engineering, WL.

The total elapsed time for completion of a Ph.D. in the School of Mechanical Engineering shall be no more than eight calendar years from date of entry into the Ph.D. program to final approval of the Ph.D. thesis by the Examining Committee. In the case of students in residence continuing beyond the Master's degree, the date of entry is defined as the start of the semester following receipt of the Master's degree. This policy applies to all students including those who register for research in absentia.

The GERC may grant an extension of the eight-year time limit upon recommendation of a student's Advisory Committee; however, such an extension will require re-approval of the Plan of Study and the retaking of Area and Preliminary Examinations.

Transfer Courses

Transfer courses placed on the POS receive the credit but the grade is not calculated into the GPA. The following rules apply for post-baccalaureate or transfer courses on the POS:

All post-baccalaureate and transfer courses used on the POS must have a grade of B- or better.

Courses taken during the semester when a student is admitted to degree-seeking status can be used as a part of the requirement above.

For the regular Ph.D. program, a maximum of nine semester credit hours of graduate coursework may be transferred from another institution or degree-awarding program. Completed courses must have a grade of B- or better and must be approved by the Advisory Committee of the student and the Graduate Chair.

For the DPh.D. program, a maximum of twelve semester credit hours of graduate coursework may be transferred from another institution or degree-awarding program. Completed courses must have a grade of B- or better and must be approved by the Advisory Committee of the student and the Graduate Chair.

The credit hours of the transfer course are not recorded on the transcript until the course is listed on the approved POS and the official transcript from the institution has been accepted at Purdue.

Ph.D. Degree Title

Students who complete the requirements for the Ph.D. or DPh.D. will receive a degree with the title "Doctor of Philosophy," with the field of study noted as "Mechanical Engineering." Note that the degree awarded is not "Doctor of Philosophy in Mechanical Engineering."

9. ENGLISH LANGUAGE PROFICIENCY REQUIREMENTS FOR INTERNATIONAL STUDENTS

Policy

Per IUPUI policy, most international students who are non-native speakers of English must take the English for Academic Purposes (EAP) Placement Test prior to registration for classes even if the TOEFL test has been taken for admissions purposes. Those applicants who obtain a TOEFL iBT score of 100 or higher, and those who obtain an IELTS score of 7.5 or higher are EAP test exempt. **The student's letter of admission from the Office of International Affairs will indicate if s/he is required to take this test**.

Admitted students from countries where English is not the predominant native language take an English for Academic Purposes (EAP) placement exam during new international student orientation the week prior to both the fall and spring semesters. This exam is a separate requirement from the Proof of English Proficiency admissions requirement.

The EAP Exam is not an admission requirement but a placement exam. IUPUI offers English for Academic Purposes (EAP) courses. The placement exam determines whether students are required to take any English courses. If so, students will take EAP courses alongside courses required for their academic program **within the first semesters of a degree program, and these EAP courses must be completed prior to graduation.** There is an additional cost for these courses.

In rare cases, an admitted student may place below IUPUI's EAP course offerings. If this happens, the student will be referred for intensive English study at the Program of Intensive English (PIE) before being allowed to begin the academic program at IUPUI.

After admission, graduate students must have permission from their program director / advisor to retake the EAP Test if they place into a course as a result of their initial exam. Only one retake is possible and granted only with a valid justification.

Students who fail to take the EAP exam or those who fail to enroll in an EAP course as required by their test results will have a hold placed on their enrollment for the next semester. Holds are not placed until after students complete their first semester: This allows students who willingly comply the opportunity to take required EAP courses without the impact of registration holds until coursework has been completed. The IUPUI Graduate Office administers all Graduate EAP policy requirements and holds.

Records will be monitored at the end of each semester to ensure that courses were completed and holds are then moved/placed accordingly.

Students who wish to retake the test must provide their director / advisor valid justification. The program director / advisor will notify the student of the decision by e-mail and will copy both Melanie Mundy (mjcurfma@iupui.edu) of the EAP Program and the IUPUI Graduate Office (gradoff@iupui.edu). With adequate justification, one re-take can be granted to a student within the first two weeks of classes. The scores of the second exam stand.

SPEAK Test for International Graduate Teaching Assistants:

All non-native speaking students who will be given instructional roles that entail direct student contact (TA's, tutors, lab instructors, etc.) are required to take the SPEAK test through the EAP Program the week before classes begin.

Students who obtain a score of 50 or above on the SPEAK test may be given primary responsibility for a class or lab. Those with scores of 40-49 may serve as a tutor, grader, class assistant, or lab assistant while taking G520 in the EAP Program. Students who obtain a score lower than 40 must take G520 prior to holding any position with direct student contact.

10. RESIDENCY AND LOAD

Semester Load. To qualify as a full-time student, a student must either

- Be enrolled for at least eight (8) credit hours or
- Hold a *Student Academic Appointment* as a research or teaching assistantship and be enrolled for at least six (6) credit hours.

All international students must be enrolled full-time to maintain visa status.

Residency Requirements. The total number of hours of academic credit used to satisfy residency requirements consists of all course credit hours that appear on the POS taken at IUPUI while enrolled in a graduate degree program and passed with grades of "C" or better; and thesis/ dissertation research hours that appear on the transcript. At least eighteen (18) of the total credit hours used to satisfy degree requirements must be earned in residence on the IUPUI campus where the degree is to be granted.

11. REGISTRATION

Registration. The registration period begins on approximately October 21 for the spring semester and March 21 for summer sessions and the fall semester. All current MEE graduate students are encouraged to register online through the *one.iu.edu* student information system during the open registration period (October-November and March-April). Note that late registration incurs a penalty fee. You are highly encouraged to select your courses and register early, as the department's decisions to cancel courses that have low enrollment may affect your course options.

Dropping/Adding Courses. Be aware of procedures, late fee charges, and refund deadlines for the dropping and adding of courses. Students may drop/add courses online during the open registration period. However, once the open registration period ends, students must use a Drop/Add form to change a course. Information on procedures and deadlines are available on the *Registrar's website* at http://registrar.iupui.edu/

12. MINIMUM GRADE REQUIREMENTS

Good Academic Standing. The Department of Mechanical and Energy Engineering maintains the following minimum standards to be in "good academic standing" in the

Master's degree program.

To be in good academic standing, a Ph.D. student must maintain a cumulative grade point index of at least 3.00 out of 4.00 in the courses on his/her Plan of Study. A graduate student who is not in good standing at the end of the semester is automatically placed on "*academic warning*" and is provided with an "academic warning" form via e-mail. Registration is restricted when students are placed on "*academic warning*". Students on academic warning are required to meet with their faculty & academic advisors and complete the "Academic Warning Form" in order for the Advising Hold to be temporarily released for registration that semester. Should the student's cumulative grade point index remain below 3.00 at the end of the succeeding semester or summer session, he/she will be placed on Academic Probation. A student on Academic Probation may not be permitted to register for further graduate courses, pending academic review and approval by the MEE Graduate Committee.

The cumulative grade point index is calculated using the courses that are on the Plan of Study. If a course is taken more than once while the student is enrolled as a graduate student, only the most recent grade received in the course will be used in computing the grade point index. Transfer courses are not included in the computation of the cumulative grade point average. No grade of "D' or "F" is allowed for a course that is on the approved Plan of Study. *All Ph.D. students must achieve a final cumulative grade point index of 3.00 or higher for courses that are on the Plan of Study.* Any course on the Plan of Study that carries a grade of "D" or "F" must be repeated. In the event of a deficiency in the cumulative grade point index, a course may be repeated but only the most recent grade received will be used in computing the index.

13. CHANGES IN ACADEMIC PROGRAM

As a student's academic program progresses, conditions may arise that make it necessary to amend the program and/or the Plan of Study. Such changes, when based on appropriate academic reasons, may be acceptable. However, there are regulations to observe when amending either the program or the POS:

Change to the Academic Program

A course may *not* be removed from an approved Plan of Study once the course has been taken and a grade of "D" or lower is received. This is a Graduate School rule.

Any change to a Plan of Study requires approval of the student's Advisory Committee and the MEE Graduate Chair.

Change to the Plan of Study. To make changes to an approved Plan of Study, Graduate School Form 13 *Request for Change to the Plan of Study* must be completed and filed with the Purdue Graduate School. This e-form is also used to request for a change of Major Professor and/or other advisory committee members, or for a change of the Ph.D. degree option. The form is available from the School's Graduate Engineering Programs Office or from the website at: http://www.engr.iupui.edu/sites/graduateprograms/current-students/index.php

14. INACTIVE ACADEMIC STATUS

Students who do not enroll in classes for three (3) consecutive academic sessions, including summer sessions, will be automatically placed on ***inactive academic status***.

Students on inactive academic status are required to submit a new graduate application for re-admission to the program before they are permitted to enroll again. Completing and submitting a new application is a formal procedure to reactivate inactive academic status. Not all other supporting application materials are *required* for re-admission.

The Purdue University Graduate School must officially approve any application for re-admission before a student can enroll in classes. Registration activities which take place while on inactive academic status and before the application for re-admission has been officially approved by the Graduate School are considered to be invalid registrations and will not count toward graduate credit.

15. PETITIONS TO THE GRADUATE COMMITTEE

All graduate students have the right to petition the Mechanical Engineering GERC for exceptions to an existing rule, if they feel that circumstances are sufficiently unusual to warrant special considerations. Such petitions should be delivered in writing to the Chair of the GERC and must include the approval (or disapproval) of each member of the student's advisory committee.

APPENDIX A

CANDIDACY REGISTRATION REQUIREMENTS

Candidacy registration is required of all graduate students in the final semester of their plan of study. The Graduate School has three options to choose from in order to certify awarding of the degree (graduation) at the end of a fall, spring or summer term.

CAND 99100 is zero credit (0) and zero cost ($0)

All Thesis and Non-Thesis Graduate Students who are:

- Enrolled in at least 1 credit of fee-bearing coursework, i.e. regular course(s), directed project, or thesis credit(s)

**Best value with least effort*

CAND 99200 is zero credit (0) with a fee of $125

Thesis Graduate Students who have:	**Non-Thesis Graduate Students who have:**
Completed all degree requirements Passed the final oral examination HAVE NOT YET completed a thesis deposit	Completed all degree requirements HAVE NOT YET completed the Directed Project ***OR*** (not both) HAVE NOT YET resolved one or more grades of Incomplete (**I**)
FAILURE to successfully deposit the thesis with the Graduate School within the first 7 weeks of the term will require:	FAILURE to successfully resolve all Incomplete (**I**) grades by the end of the term will require:
1. Withdrawal from CAND 99200 2. Late registration into CAND 99100 3. Late registration into at least 1 thesis research credit 4. Payment of all late registration fees and credit hour costs	1. A grade of "F" to be assigned for CAND 99200 2. Enrollment in CAND 99100 the subsequent term 3. Enrollment in a *fee-bearing* course the subsequent term 4. Resolution of all remaining grades of Incomplete (**I**)

**Ok value and minimum effort "Degree Only Registration."*

CAND 99300 is zero credit (0) with a fee of $125

Thesis Graduate Students who have:	**Non-Thesis Graduate Students who have:**
Completed all degree requirements but HAVE NOT YET passed the final oral examination or HAVE NOT YET completed a thesis deposit	Completed all degree requirements but HAVE NOT YET completed the Directed Project ***AND*** HAVE NOT YET resolved one or more
FAILURE to successfully deposit the thesis with the Graduate School within the first 7 weeks of the term will require:	FAILURE to successfully resolve all Incomplete (**I**) grades by the end of the term will require:
1. Withdrawal from CAND 99300	1. A grade of "F" be assigned for CAND 99300
2. Late registration into CAND 99100	2. Enrollment in CAND 99100 the subsequent term
3. Late registration into at least 1 thesis research credit	3. Enrollment in a *fee-bearing* course the subsequent term
4. Payment of all late registration fees and credit hour costs	4. Resolution of all remaining grades of Incomplete (**I**)

**Least value and most effort. Exam only registration.*

APPENDIX B

ME GRADUATE FACULTY IDENTIFIERS

Graduate Faculty Identifiers must be listed on the Plan of Study following each Committee member's signature. The following is a list of Graduate Faculty Identifiers:

AGARWAL, MANGILAL	X0615
ANWAR, SOHEL	X0460
CHEN, JIE	X0229
DALIR, HAMID	X0844
EL-MOUNAYRI, HAZIM A.	X0362
HOLGUIN, NILSSON	
JONES, ALAN S.	X0481
KATONA,THOMAS R.	X0337
LARRIBA-ANDALUZ, CARLOS	X0779
NALIM, M. RAZI	X0361
NEMATOLLAHI, KHOSROW	X0505
RAZBAN, ALI	X0689
RYU, JONG EUN	X0739
SMITH, CRAWFORD FRED	X0571
TOVAR, ANDRES	X0670
WAGNER, DIANE	X0778
WASFY, TAMER,M.	X0657
XIE, JIAN	X0554
YANG, SHENGFENG	X0865
YU, HUIDAN (WHITNEY)	X0671
ZHANG, JING	X0672
ZHU, LIKUN	X0627

An updated listing of MEE graduate faculty identifiers can be accessed at https://ias.itap.purdue.edu/rgs/wgb_faccert.disp_faculty_codes?in_header=0&in_var1=5555&in_var2=776115 .

APPENDIX C

GRADUATE SCHOOL FORMS

All graduate program-related forms may be obtained either from the School's Graduate Engineering Programs Office (ET 215) or directly from the internet by accessing the Graduate Program web pages on the MEE Department's website: http://www.engr.iupui.edu/me/fgrad.html.

There are at least six graduate school forms associated with the Ph.D. programs: These forms (samples are attached in the following pages in the handbook) are included:

- Graduate School Form 4: Request for Doctoral Plan of Study Approval
- Graduate School Form 8: Request for Appointment of Examining Committee
- Graduate School Form 9: Dissertation Acceptance
- Graduate School Form 10: Report of the Preliminary Examination
- Graduate School Form 11: Report of the Final Examination
- Graduate School Form 13: Request for Change to the Plan of Study
- GS-32, Thesis/Dissertation Agreement, Publication Delay, and Copyright Disclaimer

APPENDIX D

FINAL ORAL EXAMINATION (DISSERTATION DEFENSE)

This appendix describes the procedures of scheduling and completing the final oral examination (dissertation defense). The final exam must be scheduled three weeks prior to the examination date by filing the Graduate School Form 8 *Request for Appointment of Examining Committee*. At the time of scheduling, the student should provide the Graduate Coordinator in the Graduate Programs Office, ET 215, with a hardcopy of his/her dissertation abstract. The abstract together with the time and location of your final examination will be distributed to all MEE faculty members and will also be posted on the graduate bulletin board.

PREPARATION OF RESEARCH THESIS AND FINAL ORAL EXAMINATION (DEFENSE)

Download *A Manual for the Preparation of Graduate Theses* from the following Purdue University Graduate School website: https://www.purdue.edu/gradschool/documents/thesis/graduate-thesis-manual.pdf. The manual provides specific instructions on organizing, formatting, and binding the thesis.

Before proceeding to write your thesis, make an appointment to meet with the Graduate Engineering Coordinator in ET 215 for a briefing on dissertation formatting requirements and preparing for thesis defense. You are strongly advised to consult with your Major Professor to review your plans for preparing the thesis.

At least three weeks prior to the defense, deliver a draft copy of the thesis to members of your examining committee.

All necessary paperwork and the final oral exam must be completed by their deadlines. Be sure to have a copy of *Graduation Deadlines* for the semester you intend to graduate. A copy of *Graduation Deadlines* can be obtained from the Graduate Programs Office (ET 215) or the MEE department (SL 260).

On the day of the final exam, your Major Professor should pick up your exam forms from the School's Graduate Programs Office (ET 215). Two exam forms need to be signed by your examining committee: Graduate School Form 11 *Report of Final Examination* and Graduate School Form 9 *Dissertation Acceptance*. Immediately after your oral exam, Form 11 must be signed and returned by your Major Professor to the Graduate Coordinator in the Graduate Programs Office, ET 215. Keep Form 9 *Dissertation Acceptance* until you have made all necessary revisions to your thesis requested by your examining committee and have obtained all of the required signatures on the form.

After you have completed all revisions, the Graduate Engineering Coordinator must thoroughly check and formally approve the thesis formatting before the dissertation is deposited. Allow sufficient time to make any changes necessary to ensure that the thesis is in compliance with format requirements of the Purdue Graduate School.

Obtain all necessary signatures on the Dissertation Acceptance form and include the original form on the front of the thesis to be electronically filed.

ENROLLING IN APPROVED CLASSES AT PURDUE WEST LAFAYETTE PWL AND ONLINE VIA PROED

Below is information for PhD ME students who need to register for classes at Purdue West Lafayette.

1. Complete a free, non-degree Electronic Application.

Select the following:

Campus: Select "West Lafayette"
Proposed Graduate Major: Select "Mechanical Engineering"
Enrollment Objective: Select "Non-degree"

Provide proof of your undergraduate degree (i.e. copy of your diploma and/or official transcript with degree awarded and conferral date).

Note: *As long as you select your enrollment objective as non-degree, this will bypass the letters of recommendation, statement of purpose, diversity essay and the application fee.*

2. Admission Decision: You will receive an email from the Graduate School regarding your admission decision. Follow the instructions within.
3. Accept Your Admission: Once officially admitted by the Graduate School, you will accept your admission.
4. Onboarding Emails: You will start to receive a series of onboarding emails. Familiarize yourself with their contents and refer to as needed.
5. Register in myPurdue: You will need the course reference number (CRN) and your registration PIN.

A few important things to keep in mind.

a. The **reduced, regional tuition** rate is determined by your residency classification:

A 3-credit course for a regional, non-resident is $3011.00 and for a regional, resident is $1922.00. *(**Note:** These rates are good through summer 2018; rates starting fall 2018 have yet to be finalized and are subject to change. Please check with MEE advisors for updated rates.)*

b. If applicable, instructions on setting up **third party billing** to IUPUI can be found here (scroll down to Third-Party Payment): https://engineering.purdue.edu/ProEd/courses-tuition/tuition/paying-for-courses.

Important: Do not neglect this step or you run the risk of being dropped from your class for non-payment and would have to initiate a series of steps in order to be re-added to the class.

*Special note: **Reciprocal agreements** are only valid to PWL on-campus courses which do not apply to our distance courses. We have an approved (significantly reduced) distance tuition rate for regional campus students as an effort to support the Purdue system of campuses which may not have the ability to offer as many online graduate engineering courses.*

c. **Fee remissions** for graduate staff/research/TA appointments do not apply to distance tuition.

Questions?

Contact ProEd for questions pertaining to PWL online course registration steps, available online courses, how to drop a class, the exam process, and lecture access. (These will also be within the onboarding emails.) Email: proed@purdue.edu Phone: 765-494-7016

Contact Mechanical Engineering at Purdue for questions pertaining to the application process and your registration PIN. ***Email:*** PurdueME@purdue.edu ***Phone:*** 765-496-1544

Please alert MEE at IUPUI when you are registering for distance courses:
Monica Stahlhut mstahlhu@iupui.edu
CC: Jerry Mooney jtmooney@iupui.edu

Below is information for Ph.D. ME students who wish to take distance courses at the West Lafayette location who have never taken a distance course through Engineering Professional Education.

ONLINE CLASS

1. Electronic Application. The application fee is waived for non-degree seeking students. Please be sure to select the following -
   - Campus: Select "West Lafayette"
   - Proposed Graduate Major: Select "Mechanical Engineering"
   - Enrollment Objective: Select "Non-degree"

Note: As long as you select your enrollment objective as non-degree, this will bypass the letters of recommendation, statement of purpose essay and the application fee.

2. Proof of your undergraduate degree is also required. You may either fax (765-494-6628) or scan to an email (hbagshaw@purdue.edu) a copy of your diploma or official transcript (stating the degree/date awarded). I have also had several applicants send me a picture of their diploma sent via email JPG. This will be acceptable, as long as it is legible.

3. A resume must be uploaded to the application.

4. Proof of your graduate acceptance to the IUPUI campus. You may either fax (765-494-6628) or scan to an e-mail your welcome letter into the IUPUI program.

Then, once officially admitted by the Graduate School, Sarah Post (sepost@purdue.edu) will need the following prior to registration:

1. An e-mail from your plan of study chair approving the PWL course for which you wish to register **(*required each semester*)**
   - Note: A maximum of 4 courses/12 credits may be taken from PWL toward your IUPUI degree
2. A statement from you on how you will pay for the course

- If the course is approved by your committee chair, you will be eligible for the reduced regional tuition rate determined by your residency classification. A 3-credit course for a regional non-resident is $3011.00 and for a regional resident is $1922.00.
    - When applicable, third-party billing to IUPUI is permitted only if specifically requested by your committee chair.
    - Special note: Reciprocal agreements are only valid for PWL on-campus courses and do not apply to our distance courses. We have an approved (significantly reduced) distance tuition rate for regional campus students in an effort to support the Purdue system of campuses which may not have the ability to offer as many online graduate engineering courses.
- Note: Fee remission for graduate staff/research/TA appointments does not apply

If you have difficulty with registration or have further questions regarding this process, please contact Heather Bagshaw hbagshaw@purdue.edu or Julayne Moser moser@purdue.edu.

Appendix B

Appendix B.1 Faculty and Qualifications

The Department of Mechanical and Energy Engineering consists of 20 full time faculty. One of them is the Chancellor of IUPUI. Two of them are lecturers with teaching as their primary responsibility. In addition, one tenure-track faculty member has his primary appointment with another department. He teaches and supervises mechanical engineering graduate students. The research faculty in the department are very active in research. They have strong publication, patent, and research-funding records, which are well reflected in the faculty brief CVs shown in Appendix B-3. As a result, the departmental research expenditures have been increasing significantly in the recent years, Fig. B-1. The faculty's research is primarily sponsored by the external funding agencies. The active external grants received by the faculty are shown in Table B-1. These research funds have been primarily used to support graduate students, particularly the Ph.D. students. Table B-2 shows the funding source of the Ph.D. students in the past five years. The students are supported by faculty as the research assistant (RA), by the department as the teaching assistant (TA), by the university as fellowship student, or by corporation for the part-time students. The increase of the Ph.D. students strengthened our faculty research programs, which contributed to the significant increase in faculty productivities. The faculty and their expertise are listed in Appendix B.1, their backgrounds are listed in B.2, and their 2-page CVs in B.3.

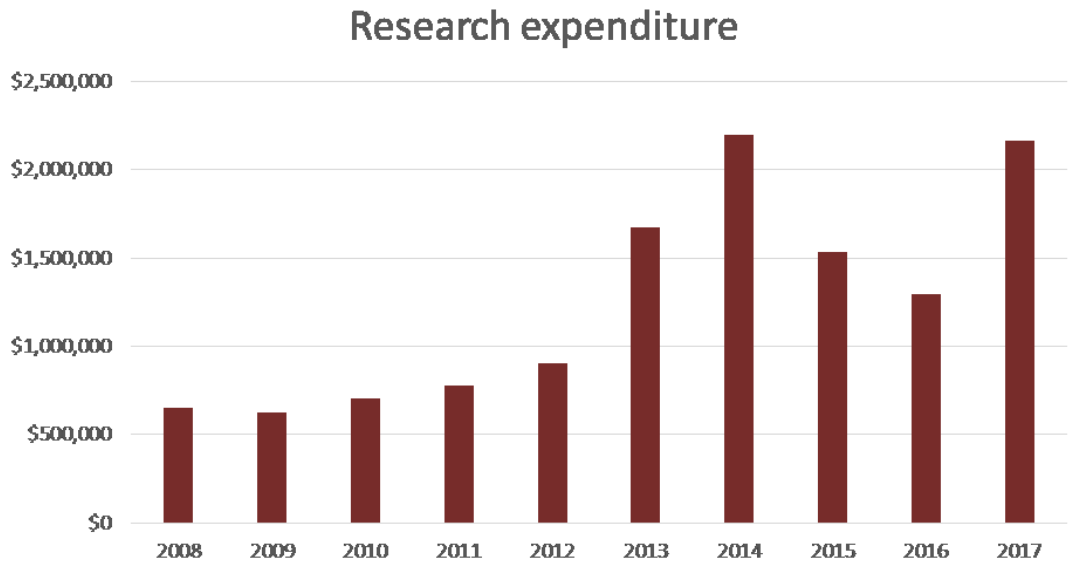

Fig. B.1 The departmental research expenditure since 2008

Grant Name	Sponsor	Pi	Start	End	Amount	Active
Nanotechnology Experiences for Students & Teachers (NEST) (ITEST)	NSF	Agarwal, Mangilal	2/1/2016	1/31/2019	1,061,245.00	TRUE
Canine-inspired smart sensor for detecting hypoglycemia from human breath	NSF	Agarwal, Mangilal	9/1/2015	8/31/2019	738,311.00	TRUE
REU: Multidisciplinary research for undergraduates in nanomaterials for energy and biological applications	NSF	Agarwal, Mangilal	3/15/2017	2/28/2020	359,848.00	TRUE
NRT-IGE: Promoting Creativity in Engineering/Technology Graduate Education through Integration of Arts/Design and Experiential Learning in the Curriculum	NSF	Anwar, Sohel	9/1/2016	8/31/2019	452,958.00	TRUE
Multi-Objective Optimization of Range Extended Electric Vehicle for Powertrain Design and Energy Management	CUMMINS	Anwar, Sohel	7/1/2018	6/30/2020	153,787.00	TRUE
Industrial Assessment Center integration of education & practice	US DEPT OF ENERGY	Chen, Jie	10/1/2016	9/30/2021	1,570,000.00	TRUE
Inverted Mobility Analysis Techniques for Aerosol Particles: Construction and testing of an inverted drift tube	KANOMAX HOLD	Larriba Andaluz, Carlos	4/1/2017	3/31/2019	98,220.00	TRUE
PRF FY 18-19	PURDUE UNIVERSITY	Nalim, Mohamed Razi	7/1/2018	6/30/2019	44,624.00	TRUE
Summer Internship at IUPUI	KING ABDULAZIZ UNIV	Nalim, Mohamed Razi	5/5/2018	5/4/2023	46,000.00	TRUE
Engineering Science Intellectual Property Project	IEDC	Piroozi, Hamid	3/1/2018	2/28/2019	150,000.00	TRUE
CLEAResult industrial facility energy assessment	CLEARESULT	Razban, Ali	2/12/2018	12/31/2018	24,000.00	TRUE
EFFECTIVE SYSTEM THERMAL EFFICIENCY OF HTHV DIRECT FIRED HEATER	THERMO CYCLER INDUSTRIES	Razban, Ali	8/1/2018	5/31/2019	37,455.00	TRUE
Integration of Plasmonic Architectures with Infrared Image Sensor Arrays	AIR FORCE RESEARCH LAB	Ryu, Jong Eun	11/13/2017	2/25/2021	360,000.00	TRUE
Multi-material, multi-objective topology optimization using extended hybrid cellular automata (gmHCA-MM)?Phase II and III	General Motors	Tovar, Andres	4/1/2017	12/31/2018	100,000.00	TRUE
Photo-initated Crosslinking as a Preventative Treatment for Post-traumatic OA	NIH-NIAMS	Wagner, Diane	7/1/2016	6/30/2020	1,300,000.00	TRUE
ADV: Mesoporous Carbon-Based PGM-Free Catalyst Cathodes	US DEPARTMENT OF ENERGY	Xie, Jian	9/11/2018	9/30/2019	1,002,789.00	TRUE
Collaborative Research: Kinetic-based self-transitioning turbulence modeling for pulsatile flows	NSF	Yu, Whitney	8/15/2018	7/31/2021	350,872.00	TRUE
Student Support: 2019 Metal Powder Industries Federation (MPIF) Annual Conference, Phoenix, AZ, June 23- 26, 2019	NSF	Zhang, Jing	9/1/2018	11/30/2019	6,333.00	TRUE
Development of ceramic core for fabricating 450mm impeller with flow thickness of 4mm based on 3D printing technology, and its commercialization technology	JIN SUNG PRECISION METAL	Zhang, Jing	5/1/2017	12/31/2019	39,848.00	TRUE
Development of repair and maintenance technology for high-temperature parts in gas turbines of F class	CHANGWON NATL UNIV	Zhang, Jing	5/1/2018	12/31/2020	85,000.00	TRUE
Collaborative: Dynamics of chalcogenide-doped high capacity lithium-ion battery anode materials during cycling using in situ imaging	NSF	Zhu, Likun	8/1/2016	7/31/2019	200,022.00	TRUE

Table B.1 Active grants received by the faculty

Table B.2 Five Year History of Mechanical Engineering Ph.D. Students and Funding

B.2-1 Summary

	Number of Students - Type of Funding					
Academic Year	Research Assistantship (RA)	Teaching Assistantship (TA)	Fellowship Funding (1)	Part-time (Corp. sponsored)	Total PhD Students	Campus of Funding
2018-2019	10.9	14.6	3.8	5.7	35.0	IUPUI Indianapolis
2017-2018	9.8	10.0	2.2	3.0	25.0	IUPUI Indianapolis
2016-2017	7.7	13.5	0.8	2.0	24.0	IUPUI Indianapolis
2015-2016	7.3	5.4	0.8	4.5	18.0	IUPUI Indianapolis
2014-2015	5.2	3.8	0.0	0.0	9.0	IUPUI Indianapolis

B.2-2 2014

Primary La	Primary First Name	Research Assistantship (RA)	Teaching Assistantship (TA)	Fellowship Funding (1)	Part-time (Corp. sponsored)	Campus of Funding
Chen	Rou	40%	60%			Indianapolis - IUPUI
Guo	Xingye	100%				Indianapolis - IUPUI
Lim	Cheol Woong		100%			Indianapolis - IUPUI
Liu	Kai	36%	64%			Indianapolis - IUPUI
Paik	Kyong-Yup	100%				Indianapolis - IUPUI
Promyoo	Rapeepan	27%	73%			Indianapolis - IUPUI
Wu	Linmin	100%				Indianapolis - IUPUI
Wu	Tong	100%				Indianapolis - IUPUI
Zhang	Yi	18%	82%			Indianapolis - IUPUI
						Indianapolis - IUPUI

B.2-3 2015

Primary Last Name	Primary First Name	Research Assistantship (RA)	Teaching Assistantship (TA)	Fellowship Funding (1)	Part-time (Corp. sponsored)	Campus of Funding
Ali	Ammar		50%		50%	Indianapolis - IUPUI
Chen	Rou	90%	10%			Indianapolis - IUPUI
Chen	Xi	95%	5%			Indianapolis - IUPUI
Feyz	Mohammad Ebrahim		100%			Indianapolis - IUPUI
Foltz	Adam				100%	Indianapolis - IUPUI
Guo	Xingye	50%	50%			Indianapolis - IUPUI
Lim	Cheol Woong	90%	10%			Indianapolis - IUPUI
Liu	Kai	90%	10%			Indianapolis - IUPUI
Pramanik	Sourav				100%	Indianapolis - IUPUI
Promyoo	Rapeepan	30%	70%			Indianapolis - IUPUI
Raeisi	Sajjad	90%	10%			Indianapolis - IUPUI
Snyder	Benjamin				100%	Indianapolis - IUPUI
Wu	Linmin		100%			Indianapolis - IUPUI
Wu	Tong	100%				Indianapolis - IUPUI
Yang	Fan		23%	77%		Indianapolis - IUPUI
Zamani Farahani	Mahmoud Reza				100%	Indianapolis - IUPUI
Zhang	Yi	100%				Indianapolis - IUPUI
Zhou	Xinwei		100%			Indianapolis - IUPUI

B.2-4 2016

Primary Last Name	Primary First Name	Research Assistantship (RA)	Teaching Assistantship (TA)	Fellowship Funding (1)	Self-Supported	Campus of Funding
Ali	Ammar		100%			Indianapolis - IUPUI
Bhargav	Amruth		100%			Indianapolis - IUPUI
Chen	Rou	18%	82%			Indianapolis - IUPUI
Chen	Xi	13%	87%			Indianapolis - IUPUI
Cui	Yi	20%	80%			Indianapolis - IUPUI
Feyz	Mohammad Ebrahim		100%			Indianapolis - IUPUI
Foltz	Adam				100%	Indianapolis - IUPUI
Guo	Xingye		100%			Indianapolis - IUPUI
Jahan	Suchana Akter		23%	77%		Indianapolis - IUPUI
Khan	Md Nazmuzzaman		100%			Indianapolis - IUPUI
Kim	Jeonghwan		100%			Indianapolis - IUPUI
Lim	Cheol Woong	100%				Indianapolis - IUPUI
Liu	Kai	100%				Indianapolis - IUPUI
Pramanik	Sourav				100%	Indianapolis - IUPUI
Promyoo	Rapeepan	100%				Indianapolis - IUPUI
Raeisi	Sajjad	100%				Indianapolis - IUPUI
Sego	Timothy	9%	91%			Indianapolis - IUPUI
Wu	Da-Chun	58%	42%			Indianapolis - IUPUI
Wu	Linmin	100%				Indianapolis - IUPUI
Wu	Tong	33%	67%			Indianapolis - IUPUI
Yang	Fan	4%	96%			Indianapolis - IUPUI
Zamani Farahani	Mahmoud Reza		100%			Indianapolis - IUPUI
Zhang	Yi	100%				Indianapolis - IUPUI
Zhou	Xinwei	17%	83%			Indianapolis - IUPUI

B.2-5 2017

Primary Last Name	Primary First Name	Research Assistantship (RA)	Teaching Assistantship (TA)	Fellowship Funding (1)	Part-time (Corp. sponsored)	Campus of Funding
Chen	Rou	18%	82%			Indianapolis - IUPUI
Chen	Xi	100%				Indianapolis - IUPUI
Cui	Yi	63%	37%			Indianapolis - IUPUI
Feyz	Mohammad Ebrahim	19%	81%			Indianapolis - IUPUI
Foltz	Adam				100%	Indianapolis - IUPUI
Golub	Michael				100%	Indianapolis - IUPUI
Jahan	Suchana Akter		100%			Indianapolis - IUPUI
Joukar	Amin		100%			Indianapolis - IUPUI
Kane	Stephen				100%	Indianapolis - IUPUI
Khan	Md Nazmuzzaman		100%			Indianapolis - IUPUI
KHATTAB	MOHAMMED	100%				Indianapolis - IUPUI
Li	Tianyi	80%	20%			Indianapolis - IUPUI
Liu	Kai	28%		72%		Indianapolis - IUPUI
Meng	Lingbin		100%			Indianapolis - IUPUI
Noori Dokht Harab	Hessam	100%				Indianapolis - IUPUI
Raeisi	Sajjad	100%				Indianapolis - IUPUI
Sego	Timothy	13%	87%			Indianapolis - IUPUI
Shewale	Mahesh		100%			Indianapolis - IUPUI
Valladares Guerra	Homero		23%	77%		Indianapolis - IUPUI
Wu	Da-Chun	100%				Indianapolis - IUPUI
Wu	Linmin	28%		72%		Indianapolis - IUPUI
Wu	Tong	100%				Indianapolis - IUPUI
Yang	Fan	63%	37%			Indianapolis - IUPUI
Zhang	Yi	50%	50%			Indianapolis - IUPUI
Zhou	Xinwei	14%	86%			Indianapolis - IUPUI

B.2-6 2018

Last Name	First Name	Research Assistantship (RA)	Teaching Assistantship (TA)	Fellowship Funding (1)	Part-time (Corp. sponsored)	Campus of Funding
Ali	Ammar				100%	Indianapolis - IUPUI
BHADOURIA	NEHARIKA		100%			Indianapolis - IUPUI
Biswas	Pias Kumar		100%			Indianapolis - IUPUI
Chen	Rou	11%	89%			Indianapolis - IUPUI
Chen	Xi		100%			Indianapolis - IUPUI
Cui	Yi	28%		72%		Indianapolis - IUPUI
Fang	Xiaoting	100%				Indianapolis - IUPUI
Feyz	Mohammad Ebrahim		28%	72%		Indianapolis - IUPUI
Foltz	Adam				100%	Indianapolis - IUPUI
Golub	Michael				100%	Indianapolis - IUPUI
Jahan	Suchana Akter		100%			Indianapolis - IUPUI
Joukar	Amin	100%				Indianapolis - IUPUI
Kapadia	Behram	15%			85%	Indianapolis - IUPUI
Khan	Md Nazmuzzaman		100%			Indianapolis - IUPUI
KHATTAB	MOHAMMED	100%				Indianapolis - IUPUI
LI	CHENZHAO		100%			Indianapolis - IUPUI
Li	Tianyi	8%	92%			Indianapolis - IUPUI
Li	Zhiguang	100%				Indianapolis - IUPUI
Meng	Lingbin		100%			Indianapolis - IUPUI
Moheimani	Reza	100%				Indianapolis - IUPUI
Najmon	Joel		23%	77%		Indianapolis - IUPUI
Noori Dokht Harab	Hessam	4%	96%			Indianapolis - IUPUI
Raeisi	Sajjad	100%				Indianapolis - IUPUI
Sego	Timothy	5%	95%			Indianapolis - IUPUI
Shafiee	Abbas		100%			Indianapolis - IUPUI
Shewale	Mahesh		100%			Indianapolis - IUPUI
Snyder	Benjamin	15%			85%	Indianapolis - IUPUI
Valladares Guerra	Homero	52%	48%			Indianapolis - IUPUI
Wang	Hua	100%				Indianapolis - IUPUI
Warren	John				100%	Indianapolis - IUPUI
Wu	Da-Chun	100%				Indianapolis - IUPUI
Wu	Tong	100%				Indianapolis - IUPUI
YANG	XUEHUI		23%	77%		Indianapolis - IUPUI
Zhang	Xiaoyu		23%	77%		Indianapolis - IUPUI
Zhou	Xinwei	56%	44%			Indianapolis - IUPUI

B.1 List program faculty and administrators. Include area of specialization for each faculty member.

Name	Rank	Specialty	Graduate Faculty
Eric Adams	Senior Lecturer	Thermo-Fluid	No
Mangilal Agarwal	Associate Professor	Nano Technology	Yes
Sohel Anwar	Associate Professor and Chair of GERC	Mechatronics and Control	Yes
Jie Chen	Professor and Chair	Biomechanics, Energy, Design	Yes
Hamid Dalir	Associate Professor	Composites	Yes
Hazim El-Mounayri	Associate Professor	Manufacturing	Yes
Steven James	Lecturer	Solid Mechanics	No
Alan Jones	Associate Professor and Associate Chair	Materials	Yes
Carlos Larriba-Andaluz	Assistant Professor	Thermo-fluid	Yes
Razi Nalim	Professor and Associate Dean	Thermo-fluid	Yes
Nilsson Holguin	Assistant Professor	Biomechanics	Yes
Nasser Paydar	Professor and Chancellor	Solid Mechanics	Yes
Ali Razban	Clinical Associate Professor	Control, Mechatronics, Energy	Yes
Jong Eun Ryu	Assistant Professor	Nano-technology	Yes
Andres Tovar	Associate Professor	Design, Manufacturing	Yes
Diane Wagner	Associate Professor	Biomechanics	Yes
Jian Xie	Professor	Energy	Yes

Shengfeng Yang	Assistant Professor	Computational Mechanics	Yes
Huidan (Whitney) Yu	Associate Professor	Thermo-fluid	Yes
Jing Zhang	Associate Professor	Materials, Energy	Yes
Likun Zhu	Associate Professor	Thermo-fluid, Energy	Yes

B.2 Brief CV of the graduate faculty

Adams, Eric

Eric Adams is Senior Lecturer in Mechanical Engineering at IUPUI. He graduated with a Ph.D. in Mechanical Engineering from Stanford University in 1984. In addition to MS and Ph.D. in Mechanical Engineering, Dr. Adams holds an MS in Applied Statistics from Purdue University (IUPUI) from 2009. Dr. Adams has spent over 25 years in Industry with responsibilities in research, design, reliability and quality. His interests include: Refrigeration and Air Conditioning, Indoor Air Quality, Statistics and Design of Experiments, Reliability, Robust Design, Design of Thermal Systems, Lean Manufacturing & Applications of Lean Manufacturing to Office Environments

Agarwal, Mangilal

Dr. Mangilal Agarwal, Associate Professor, l received his M.S. (2002) and Ph.D. (2004) in Engineering from Louisiana Tech University (Ruston, LA). After his Ph.D., he was a Postdoctoral Research Associate at Louisiana Tech's Institute for Micromanufacturing, which was followed by an appointment as Research Assistant Professor there. He joined IUPUI in 2009 as the Associate Director for Research Development in the Office of the Vice Chancellor for Research. Dr. Agarwal is currently Associate Professor of Mechanical Engineering and Director of Integrated Nanosystems Development Institute (INDI) at IUPUI. His area of research is within the interdisciplinary field of nanotechnology. In particular, it focuses on the design and development of nanosystem-based electronic devices for applications in energy and medicine. Within this, he has developed two research projects that include sensor development for biomarker detection, and the design/fabrication of flexible energy devices that can be integrated into wearable sensor systems. In addition, he has contributed significantly to STEM education research where his goal is to investigate methodologies to increase STEM interest among high school students through innovative learning and learning environments.

Anwar, Sohel

Dr. Anwar is an Associate Professor in the department of MEE at Purdue School of Engineering and Technology, IUPUI. He is also the graduate program chair of the department and the director of Mechatronics research lab. He has over 23 years of combined academic and industry R & D experience in the general area of mechatronics. He received his Ph.D. from University of Arizona, Tucson, AZ in 1995. He worked as an R&D engineer at Caterpillar, Inc. between 1995 and 1999 where he focused on X-By-Wire systems design for Wheel Loaders. He then joined Ford Motor Company / Visteon Corporation in 1999 as a Senior R&D engineer where he led the fault tolerant design of Drive-By-Wire systems. He joined Purdue School of Engineering and

Technology at Indiana University Purdue University at Indianapolis (IUPUI) to develop coursework and to establish a funded research program in the area of Mechatronics and Controls in 2004.

Dr. Anwar has published over 110 papers in peer-reviewed journal and conference proceedings. He is also listed as an inventor or co-inventor on 14 US patents. Dr. Anwar's research interests include autonomous vehicle systems, electrified powertrain, diagnostics, biomechatronics, energy related technologies. His research is supported by NSF and industry. He is a member of ASME, IEEE, and a faculty advisor for SAE student chapter at IUPUI. He is on the editorial board of four international journals including IEEE Transactions on Vehicular Technology.

Chen, Jie

Dr. Chen is Professor and Chair of Department of Mechanical and Energy Engineering. He received Ph.D. from Drexel University in Mechanical Engineering and Mechanics, in 1989. He was a postdoctoral fellow in the Department of Mechanical Engineering and Mechanics, Drexel University, from 1989 to 1990. He joined IUPUI in August of 1990 as assistant Professor in Mechanical Engineering. He was promoted to Associate Professor in 1995 and to Professor in 2000. He served as the Acting Chair from 1997-1999. He has been the Chair of the department since 2008.

Dr. Chen's research interests include energy efficiency, smart manufacturing, mechanical system modeling, design, and biomechanics. Dr. Chen's research has been supported by government agencies, such as, DARPA, DOD, DOE, NIH, the private foundations, such as the Whitaker Foundation, and industries. He is currently the Director of the Indiana Industrial Assessment Center sponsored by the DOE. Dr. Chen published 141 journal and conference papers, and was awarded 2 patents.

Dalir, Hamid

Associate Professor Hamid Dalir received his Ph.D. in Mechanical Engineering at the Tokyo Institute of Technology in 2009. Dr. Dalir's research interests have revolved around different topics in the area of mechanical, automotive and aerospace engineering. His primary research interests are within the general area of Solid Mechanics and specifically on stress, modal and thermal analysis of mechanical and aerospace structures; computational mechanics; multi-disciplinary design optimization; composite materials and damage mechanics; and multi-scale modeling and material characterization. Dr. Dalir's expertise is: Advanced Multifunctional Composite Materials; Nanocomposites; Additive Manufacturing; Multi-Scale Modeling and Material Characterization; Micro and Nanotechnologies; Computational Mechanics; Multi-disciplinary Design Optimization.

El-Mounayri, Hazim

Dr. El-Mounayri is an Associate Professor of Mechanical Engineering and the director of the Initiative for Product Lifecycle Innovation (IPLI), which aims at advancing process and product lifecycle practice in the manufacturing, healthcare, and life sciences industries. He received his PhD in Advanced Manufacturing in 1997 from McMaster University in Canada. His research focus and interest are in advanced manufacturing (including nano-manufacturing, digital manufacturing, additive manufacturing, and virtual manufacturing) and advanced

product/process development for Industry 4.0. Dr. El-Mounayri has 20 years working in this field, including on applied research that aims at developing innovative advanced manufacturing solutions that are rapidly transferred to industry to improve existing practice. Dr. El-Mounayri has more than 120 publications in his areas of expertise, and is a member of INCOSE, ASME, ASEE, and SME.

Holguin, Nilsson

Assistant Professor Nilsson Holguin received his PhD from Stony Brook University in 2010 from the Dept. of Biomedical Engineering on the maintenance of the intervertebral disc by low-intensity vibrations during simulated microgravity in humans and rodents. Dr. Holguin joined the Dept. of Orthopaedic Surgery as a post-doctoral researcher and studied the molecular mechanism underlying the age-related attenuation of bone formation in response to mechanical loading and underlying the age-related and compression-related promotion of intervertebral disc degeneration. Dr. Holguin joined the Dept. of Mechanical Engineering in the summer 2017 and is also a member of the Indiana Center for Musculoskeletal Health at IUPUI. The Holguin laboratory focuses on the biomechanics and mechanobiology of the spine undergoing adaptation to aging, mechanical forces, injury and/or pharmaceutical therapies. Dr. Holguin studies how Wnt signaling, a molecular pathway responsible for cell proliferation and matrix production in many musculoskeletal tissues, may be mediated by mechanical forces to either induce degeneration of the intervertebral disc, its maintenance or repair.

Jones, Alan

Alan Jones is an Associate Professor who earned his PhD in 2003 from University of Michigan Ann Arbor. In addition Dr. Jones is the Associate Chair of Mechanical Engineering. His research interests include multi-functional materials, self-healing polymers, material degradation and failure, and virtual reality for use in engineering education.

Larriba-Andaluz, Carlos

Carlos Larriba Andaluz earned his bachelor's degree in Aerospace at the Universidad Politecnica de Madrid. He moved to the States after an abridged stay at Iberia Airlines. He received his Ph.D. in Mechanical Engineering from Yale University in 2010 followed by a postdoctoral Associate and Ramon Areces Fellow at the University of Minnesota in the Department of Mechanical Engineering. Recently (2015), he has started a tenure-track position as an Assistant Professor at the Purdue University School of Engineering and Technology in Indianapolis. His main area of research is steered towards electrosprays of ionic liquids under vacuum (used in clean electrical propulsion for satellites), dielectric electrosprays by means of charge injection atomization (for efficient production and control of fuel drop generation and combustion), Ion Mobility Spectrometry (IMS) coupled with Mass Spectrometry (MS) and developing a 2D axial symmetric, multichemistry, sectional Aerosol-Plasma model and the study of afterglow and pulsing plasmas for ion and Silane nanoparticle collection. In IMS-MS, current projects include structural characterization of large biomolecules, chemical warfare detection, liquid and solid polymers, proteins, asphaltenes, and Room Temperature Ionic Liquids. Theoretically and numerically, he has developed a suite of algorithms, freely available and used by several university departments, to calculate heat, mass and momentum transfer in the free molecular regime for all atom models using Kinetic Theory of Gases including the possibility of diffuse

reemission, polarization and vdw potentials. His long-term goal is to design a new set of parallelized algorithms that combines knowledge from DSMC and Lattice Boltzmann algorithms. He is also designing a new concept Drift Tube (IMS) for Kanomax Inc., patent pending.

Nalim, Mohamed Razi

Dr. Razi Nalim is Executive Associate Dean for Research and Graduate Programs at the School of Engineering & Technology; the Director, Combustion & Propulsion Research Laboratory; and a Professor of Mechanical Engineering. He has three decades of experience in higher education and professional practice – in industry, academia, and government. Working at NASA Glenn Research Center and Purdue University, he pioneered novel concepts for pressure-gain combustion engines and pressure-wave machines, with the potential for substantial reduction of fuel consumption and greenhouse gas emissions of aircraft and power generation engines, and extension of unmanned aerial vehicle altitude and range limits. His research has led to six patents, and over 100 publications, supported by over $10 million in grants from NASA, National Science Foundation, Rolls-Royce, and other sponsors. Recognized as a entrepreneurial 'translational' scholar at IUPUI, he helped establish multiple industry-university research consortia. He previously led R&D at two small start-up companies, and has launched a startup company to commercialize his research. Dr. Nalim has been awarded the IUPUI Alvin Bynum Faculty Mentor award for guiding undergraduates, and the Abraham Max and Frank Burley Distinguished Professorships – the highest honors of his school for research and service, respectively. Dr. Nalim has lectured widely in the US, Asia and Europe. He has served overseas as a Fulbright Senior Scholar and NATO AGARD Scholar, and is an Associate Fellow of the American Institute of Aeronautics & Astronautics. Dr. Nalim earned his Ph.D. from Cornell University in Ithaca, NY in 1994.

Razban, Ali

Dr. Razban is a Clinical Associate Professor, the Director of BS in Energy Engineering Program, and the Assistant Director of the Industrial Assessment Center. He has over 15 years of industrial experience in medical device, electronics and automotive industries. He has received his Ph.D. in Mechanical Engineering from Imperial College, London, UK in 1994. He has received two grants as a Co-PI from DOE (Department of Energy). He has also received grants from Environmental Protection Agency (EPA) and industry as Principal Investigator (PI). He has over 25 publications in international journals and conferences. His research interest are: energy management, energy efficiency improvement, smart manufacturing, simulation based modeling, robotics, controls and industrial automation.

Ryu, Jong Eun

Dr. Ryu obtained his PhD in Mechanical Engineering with an emphasis on nanomaterials and scalable manufacturing in September of 2009 from the University of California, Los Angeles. Dr. Ryu continued his research career at UCLA as a post-doc before joining Intel Corp as a Senior Lithography Engineer in June 2011. He is currently an Assistant Professor in Mechanical Engineering at Indiana University-Purdue University Indianapolis (IUPUI) since August 2013. His research interests include 3D additive manufacturing, nanomanufacturing, and

multifunctional nanocomposites. Specific application areas are bio-inspired plasmonic infrared imagers, biosensors, and flexible 3D electronics (e.g. wearable electronics).

Tovar, Andres

Andres Tovar, Ph.D. is an Associate Professor of Mechanical and Energy Engineering and Adjunct Assistant Professor of Biomedical Engineering at Indiana University-Purdue University Indianapolis (IUPUI). Prof. Tovar received his B.S. in Mechanical Engineering and M.S. in Industrial Automation from the National University in 1995 and 2000, respectively. As part of his early career development, he started a company designing machines for the Colombian food industry. In 1999, Prof. Tovar worked for the Spanish R&D Center Tekniker designing ultraprecision machines. In 2001, he was selected for the prestigious Fulbright fellowship program and earned his M.S. and Ph.D. in Mechanical Engineering from the University of Notre Dame in 2004 and 2005, respectively. Prof. Tovar served as a Research Assistant Professor of Aerospace and Mechanical Engineering at the University of Notre Dame (2008-2011) and as an Assistant and Associate Professor of Mechanical and Mechatronic Engineering at the National University of Colombia (2000-2012). During his tenure at the National University, Prof. Tovar was Department Chair of and Academic Provost. At IUPUI, he has been selected Department of Athletics Favorite Professor in 2013, 2014 and 2015, Best Faculty Advisor in 2014, the recipient of the Wisner-Stoelk Outstanding Faculty Award in 2015, and the recipient of the IU Trustees Teaching Award in 2016. He also received the SAE Ralph R. Teetor Educational Award in 2014 and he was awarded by DOE/ARPA-E and Local Motors with the First Place in the 2015 LITECAR Challenge. Currently, Prof. Tovar is the director of the Engineering Design Research Laboratory at IUPUI. His main research areas include bio-inspired design optimization, multi-scale/multi-objective design methods for materials, structures, and mechanical components, and design for additive manufacturing (3D printing).

Wagner, Diane

Dr. Wagner obtained her B.S. in Mechanical Engineering from the University of Michigan and worked as a mechanical engineer in industry before pursuing her graduate degree. She obtained her Ph.D. in Mechanical Engineering from the University of California at Berkeley in 2002, where her graduate research focused on constitutive modeling of orthopaedic tissues. In her postdoctoral research at Stanford University she investigated the effects of mechanics on adult mesenchymal stem cells. She held a faculty position at Notre Dame for 10 years before transitioning to her current position as an Associate Professor in the Department of Mechanical and Energy Engineering at IUPUI. Her current research efforts are in the areas of soft orthopaedic tissue mechanics, mechanobiology and tissue engineering.

Wei, Xiaoliang (Shawn)

Dr. Wei is an Assistant Professor of the Department of Mechanical & Energy Engineering at Indiana University-Purdue University Indianapolis (IUPUI). He received his PhD in chemistry from Brown University in 2009. During 2010-2011, he was a postdoctoral research associate in the Department of Macromolecular Science & Engineering at Case Western Reserve University. Then from 2011 to 2017, he went to Pacific Northwest National Laboratory first as a post doctorate research associate, then was promoted to Scientist II and III. He joined IUPUI in January, 2018 as an Assistant Professor in the Department of Mechanical & Energy Engineering.

Dr. Wei's research interests include electrochemical energy storage, redox flow batteries, two-dimensional nanomaterials, interfacial phenomena, surface science, and materials synthesis. His research has been supported by Department of Energy. Dr. Wei was the recipient of Ronald L. Brodzinski Early Career Exceptional Achievement Award in 2016. He has produced 44 peer-reviewed journal publications, 7 patents (and applications), 14 invited conference talks, and 1 book chapter.

Xie, Jian

Dr. Xie is a professor of Mechanical Engineering at the Purdue School of Engineering Indianapolis (IUPUI campus). He has published more than 55 journal papers, four issued patents and 11 patents applications, two book chapters and he has been awarded more than $4.86 million research grants within eight years. He served as review board members for more than 12 journals including the well-known "Nature". He also serves as the panelist of the review panel for US National Science Foundation (NSF), Advanced Research Project Agency-Energy (ARPA-E), Fuel Cell Technology Office of US Department of Energy (DOE), Canadian National Science Foundation (CNSF) for grant proposal review and evaluation. He has been served as the session chair for Polymer Electrolyte Fuel Cells Symposium in the Electrochemical Society Meeting for more than five years. Before joining the university, he was a principal research scientist at Battelle Memorial Institute and worked on fuel cell R&D as well as Li-ion batteries and artificial lung. Prior to Battelle, as the program manager and senior electrochemical engineer at Cabot Corp, Dr. Xie worked extensively on catalyst development for fuel cells. Dr. Xie spent four years at Los Alamos National Laboratory on fuel cell research covering from membrane electrolytes, catalysts, membrane electrode assembly (MEA) to durability of fuel cells. As a system engineer, Dr. Xie was in charge of developing electric propulsion system for Electric Vehicle (EV) and Hybrid EV at General Motors Advanced Technology Vehicle, Indianapolis Technical Center. Dr. Xie received his PhD in chemistry from Miami University (1999), U.S.A. and BS in chemical engineering (emphasis on electrochemical engineering) from Tianjin University, China (1982).

Yang, Shengfeng

Dr. Shengfeng Yang is an Assistant Professor in the Department of Mechanical and Energy Engineering at Indiana University–Purdue University Indianapolis (IUPUI). Before joining IUPUI, he was a postdoctoral researcher at the University of California, San Diego, where he was leading the development of a computational material science tool to construct interfacial phase diagrams for metallic alloys and ceramic materials. He received his Ph.D. degree in Mechanical Engineering from the University of Florida in 2014. He has been working on many national research projects, including research funded by NSF, DARPA, Department of Energy and most recently Department of Defense. His research interests include computational mechanics, multiscale-multiphysics modeling, and scientific computing with a particular focus on the thermo-mechanical and dynamical properties of materials including metallic alloys, ceramics, biological composite, and energy conversion and battery materials.

Yu, Huidan (Whitney)

Dr. Huidan (Whitney) Yu is an Associate Professor in Department of MEE, Indiana University-Purdue University Indianapolis (IUPUI). Prior to the affiliation with IUPUI, she successively completed two PhD degrees in Physics (2001) at Peking University in China and Aerospace

Engineering (2004) at Texas A&M University in USA, followed by two postdoctoral research positions at Los Alamos National laboratory and the Johns Hopkins University. Dr. Yu's research expertise is, in general, on CFD for thermal fluids modeling on mesoscopic (Boltzmann equation) level taking advantages of suitability for multiphase flow, ease for dealing with complicated geometry, and idealization for GPU (Graphic Processing Units) parallel computing. She has 20+ years of experience creating models and performing simulations for fluid/flow systems including multiphase flow and turbulence. She is familiar with programing on different operating systems and work stations such as windows, linux/unix, as well as a wide variety of scientific and commercial software for CFD. She has been regarded as an expert for parametric analysis of flow features, such as instability, nonlinearity, pulsivity etc., through CFD supporting experimental design and product advancement. Her research over the years has produced 70+ prestigious journal papers and 70+ invited/conference talks. At IUPUI, Dr. Yu has dedicated herself to develop reliable and applicable computational tools for image-based computation analysis of biomedical flows through close collaboration with clinicians. She is the inventor of a clinically practical software named InVascular for noninvasive assessment of hemodynamic abnormalities within clinical favorite time, aiming to aid clinical diagnosis and treatment making.

Zhang, Jing

Jing Zhang is an Associate Professor of Mechanical Engineering at IUPUI. He received Ph.D. in materials science from Drexel University in 2004. His current research interests are broadly centered on understanding the processing-structure-property relationships in advanced ceramics and metals for optimal performance in application, and identifying desirable processing routes for its manufacture.

Zhu, Likun

Likun Zhu is an Associate Professor in the Department of Mechanical and Energy Engineering at IUPUI. He received his PhD degree from the University of Maryland at College Park in 2006. Dr. Zhu's research interests include advanced lithium ion batteries, microfluidics and micro/nano fabrication.

B.3 Curriculum Vitae of Graduate Faculty who supervises Ph.D. students

Mangilal Agarwal, Ph.D.
Associate Professor, Department of Mechanical Engineering
Director, Integrated Nanosystems Development Institute (INDI)
Indiana University-Purdue University Indianapolis (IUPUI)
Indianapolis, Indiana

Professional Preparation:

Osmania University, India	Electronic/Communication Engineering	B.S.	1998
Louisiana Tech University, Ruston	Electrical Engineering	M.S.	2001
Louisiana Tech University, Ruston	Electrical, Micro/Nanotechnology	Ph.D.	2004
Institute for Micromanufacturing	Micro/Nanotechnology Concentration	Postdoc	2004–2006

Appointments:

2016 – Present	Director, Integrated Nanosystems Development Institute (INDI), IUPUI, IN
2016 – Present	Associate Professor, Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI, IN
2016 – Present	Adjunct Associate Professor, Chemistry and Chemical Biology, Purdue School of Science, IUPUI, IN
2012 – Present	Adjunct Associate Professor, Electrical and Computer Engineering, Purdue School of Engineering and Technology, IUPUI, IN
2009 – 2016	Associate Director for Research Development, Office of Vice Chancellor for Research, IUPUI, IN
2012 – 2016	Interim Director, Integrated Nanosystems Development Institute (INDI), IUPUI, IN
2009 – 2012	Chair, Leadership Team, Integrated Nanosystems Development Institute (INDI), IUPUI, IN
2005 – 2009	Research Assistant Professor and Research Staff, Institute for Micromanufacturing (IfM), Louisiana Tech University, LA
2004 – 2005	Postdoctoral Researcher, Institute for Micromanufacturing (IfM), Louisiana Tech University, LA
1999 – 2004	Graduate Research Assistant, Louisiana Tech University, LA
1998 – 1999	Network Administrator, Bhoruka Roadlines Ltd., Hyderabad, India
1997 – 1998	Intern, Bharat Heavy Electrical Ltd., Hyderabad, India

Products:

Relevant Publications (*denotes undergraduate co-authors):

1. M. Teunis[†], T. Liyanage, D. Sukanta[††], B. Muhoberac, R. Sardar, and **M. Agarwal**, "Unraveling the Mechanism Underlying Surface Ligand Passivation of Colloidal Semiconductor Nanocrystals: A Route for Preparing Advanced Hybrid Nanomaterials," ACS Chemistry of Materials, 2017 (Accepted).
2. M. Teunis[†], T. Liyanage, D. Sukanta[††], B. Muhoberac, R. Sardar, and **M. Agarwal**, "Elucidating the Role of Surface Passivating Ligand Structural Parameters in Hole Wave Function Delocalization in Semiconductor Cluster Molecules," RSC Nanoscale, vol. 9, pp. 14127, 2017.
3. A. Siegel[††], A. Daneshkhah[†], D. Hardin, S. Shrestha[††], K. Varahramyan, and **M. Agarwal**, "Analyzing Breath Samples of Hypoglycemic Events in Type 1 Diabetes Patients: Towards Developing an Alternative to Diabetes Alert Dogs," Journal of Breath Research, vol. 11, no. 2, 2017.
4. M. Wu, Y. Cui, A. Bhargav, Y. Losovyj, A. Siegel, **M. Agarwal**, Y. Ma, and Y. Fu, "Organotrisulfide: A High Capacity Cathode Material for Rechargeable Lithium Batteries," Angewandte Chemie International Edition, vol. 55, no. 34, pp. 10027-31, 2016 (Hot Paper).
5. A. Daneshkhah, S. Shrestha, **M. Agarwal**, and K. Varahramyan, "Poly(Vinylidene Fluoride-Hexafluoropropylene) Composite Sensors for Volatile Organic Compounds Detection in Breath," Sensor and Actuators B, vol. 221, pp. 635-643, 2015.

Other Significant Publications:

1. A. Daneshkhah, S. Shrestha, A. Siegel, K. Varahramyan, and **M. Agarwal**, "Cross-selectivity Enhancement of Poly (vinylidene fluoride-hexafluoropropylene)-based Sensor-array for Detecting Acetone and Ethanol," Sensors, vol. 17, no.3, pp. 595, 2017.
2. M. Wu, A. Bhargav, Y. Cui, A. Siegel, **M. Agarwal**, Y. Ma, and Y. Fu, "Highly Reversible Diphenyl Trisulfide Catholyte for Rechargeable Lithium Batteries," ACS Energy Letters, vol. 1, no. 6, pp. 1221-1226, 2016.
3. N. Aliahmad, S. Shrestha, K. Varahramyan, and **M. Agarwal**, "Paper-based Poly(vinylidene fluoride-hexafluoropropylene) Polymer Electrolyte Lithium-ion Batteries," AIP Advances, vol. 6, no. 6, pp. 065206, 2016.
4. N. Aliahmad, **M. Agarwal**, S. Shrestha, and K. Varahramyan, "Paper-based Lithium-ion Batteries using Carbon Nanotube-Coated Wood Microfibers," IEEE Transaction on Nanotechnology, vol. 12, no. 3, pp. 408–412, 2013.
5. R. Promyoo, H. El-Mounayri, **M. Agarwal**, V. K. Karingula, and K. Varahramyan, "Tip-based Nanomanufacturing (TBN) of Nanofluidics Using AFM," ASME Journal of Micro and Nano-Manufacturing, vol. 4, no. 4, pp. 041003, 2016.

Synergistic Activity:

- Made significant contributions to the development of the layer-by-layer nanoassembly technique and demonstrated its applications for nanoengineering of electronic devices.
- Prepared and taught lectures and courses in the area of micro/nanoelectromechanical device design, fabrication, and operation.
- Served as a reviewer for papers submitted to the following scientific journals: American Society of Mechanical Engineers, Journal of Physics D: Applied Physics, Nanotechnology Journal, Lab on Chip, Soft Matter, Journal of Materials Chemistry, Langmuir, Synthetic Metals, Sensor and Actuators: B Chemical, Polymer Materials, Analyst, and IEEE Transactions on Nanotechnology.
- Member of Institute of Electrical and Electronics Engineers (IEEE); Material Research Society (MRS), American Society of Mechanical Engineers (ASME), American Chemical Society (ACS).
- Co-organizer of symposium on Fabrication Process of Nanomaterials and Nanodevices at ASME MSEC 2010, MSEC 2012, and MSEC 2013.

Graduate Advisors and Postdoctoral Sponsors:

Graduate and Postdoctoral Advisor*:* Dr. Kody Varahramyan (Louisiana Tech University)

Thesis Advisor and Postgraduate-Scholar Sponsor:

Graduate Students – PhD Program

Ph.D. Student Advised - Main Research Advisor: A. Daneshkhah; and Co-Research Advisor: R. Promyoo; Current Ph.D. Student Advisees - Main Research Advisor: N. Aliahmad; Committee Research Advisor: Y. Zhang

Graduate Students – MS Program

Current Graduate Students Advisees - Main Research Advisor: B. Pakki, S. Vij, S. Dgama, S. Gudimellatirumala, A. Vajjhala, and V.K. Peddinti,; Co-Research Advisor: P. Chowdhury, R. Gupta, and J. Satterwhite; Committee Research Advisor: S. Zhou

Postdoctoral Fellows

Postdoctoral Advised - Main Supervisor: S. Shrestha, C. Tripathi, and W. Kranz
Current Postdoctoral Advisees - Main Supervisor: A. Siegel; and Co-Supervisor: Y. Liu

Total Number of Graduate Students Advised: 27
Total Number of Postdoctoral Scholars Sponsored: 5

SOHEL ANWAR
Department of Mechanical Engineering, Purdue School of Engineering & Technology, IUPUI
Tel: 317-274-7640, Email: soanwar@iupui.edu

Professional Preparation

Bangladesh Univ. Eng. & Tech., Dhaka	Mechanical Engineering	BSME, 1986
Bangladesh Univ. Eng. & Tech., Dhaka	Mechanical Engineering	M.Sc.Eng., 1988
Florida State University, Tallahassee, FL	Mechanical Engineering	MSME, 1990
The University of Arizona, Tucson, AZ	Mechanical Engineering	Ph.D., 1995
The University of Arizona, Tucson, AZ	Systems/Industrial Eng.	Res. Assoc., 1995
State of Michigan, East Lansing, MI	Mechanical Engineering	P.E. License, 2004

Appointments

2010-Present	Chair, Graduate Education and Research Committee, Dept. of Mechanical Eng., IUPUI
2009-Present	Associate Professor, Dept. of Mechanical Engineering, IUPUI, Indianapolis, IN.
2013	Visiting Faculty, Dept. of Mechanical Eng., University of Melbourne, Australia.
2009	Faculty Summer Intern, Raytheon Technical Services Co., Indianapolis, IN
2004-2009	Assistant Professor, Dept. of Mechanical Engineering, IUPUI, Indianapolis, IN.
2003-2004	Adjunct Faculty, Dept. of Mechanical Eng., University of Michigan - Dearborn, MI.
1999-2004	Senior Control Systems Engineer, R & D, Ford Motor Company, Dearborn, MI.
1995-1999	Staff Consulting Engineer, Technical Services Division, Caterpillar, Inc., Peoria, IL.
1986-1988	Lecturer, Dept. of Mechanical Engineering, Bangladesh Univ. of Eng. & Tech., Dhaka.

Related Publication (5):

1. Majid Deldar, Afshin Izadian, and Sohel Anwar, "Modeling of a Hydraulic Wind Power Transfer System Utilizing a Proportional Valve", *IEEE Transactions on Industry Applications*, Vol 51, No. 2, March/April, 2015, pp. 1837-1844.
2. Afshin Izadian, Sina Hamzehlouia, Majid Deldar, Sohel Anwar, "Hydraulic Wind Power Transfer System: Operation and Modeling", *IEEE Transactions on Sustainable Energy*, 2014.
3. Majid Deldar, Afshin Izadian, and Sohel Anwar, "System Configuration and Component Sizing Methodology of a Hydrostatic Transmission for a Wind Power Plant", *ASME International Mechanical Engineering Congress and Exposition*, Phoenix, AZ, Nov. 11-17, 2016.
4. M. Deldar, A. Izadian, and S. Anwar, "Reconfiguration of a Wind Turbine with Hydrostatic Drivetrain to Maximize Annual Energy Production", *2015 IEEE Energy Conversion Congress and Exposition (ECCE 2015)*, Montreal, Canada, September 20-24, 2015.
5. Sina Hamzehlouia, Afshin Izadian, Sohel Anwar, "Modeling and Control of Hybrid-Hydraulic Electric Vehicles", *Advances in Automobile Engineering*, vol. 2, issue 1, February 2013.

Significant Publication (5):

1. Sourav Pramanik and Sohel Anwar, "Electrochemical Model Based Charge Optimization for Lithium-Ion Batteries", *Journal of Power Sources*, Volume 313, 2016, pp. 164-177.
2. Md. Ashiqur Rahman, Sohel Anwar, and Afshin Izadian, "Electrochemical Model Parameter Identification of a Lithium-Ion Battery using Particle Swarm Optimization Method", *Journal of Power Sources*, 307 (2016) 86-97.
3. R. Huq and S. Anwar, "Development of a Soot Load Sensor using Electrical Capacitance Imaging", *ASME Journal of Dynamic Systems, Measurement and Control*, Vol 137, No. 11, 2015, pp. 111009-111009-10.
4. Amardeep Sidhu, Afshin Izadian, and Sohel Anwar, "Adaptive Nonlinear Model-Based Fault Diagnosis of Li-ion Batteries", *IEEE Transactions on Industrial Electronics*, Vol 62, No. 2, February, 2015, pp. 1002-1011.
5. Amardeep Sidhu, Afshin Izadian, and Sohel Anwar, "Model Based Condition Monitoring in Lithium-Ion Batteries", *Journal of Power Sources*, Vol 268, 2014, pp 459–468.

Synergistic Activities

1. Dr. Anwar is the recipient of a recent National Science Foundation (NSF) grant in the National Research Traineeship (NRT-IGE) category for which he is the principal investigator. This project is aimed at promoting creativity and innovativeness amongst graduate students through incorporation of studio based pedagogy and immersive supervised projects via 3 new experimental graduate courses: 1) *Design of Complex and Origami Structures,* ii) *Optimal Design of Mechatronic Systems: Robots and Interactive Structures,* and iii) *Environmental Pollution & Emission Control.* Anwar's leadership experience in this NSF funded project will be useful in the proposed project, particularly with respect to nonlinear system modeling and control.
2. Dr. Anwar established three new graduate courses titled "Automotive Control", "Powertrain Integration" and "Hybrid and Electric Transportation" at IUPUI. These courses are also video streamed to engineering professional students at various industry sites across Indiana. These courses are aimed at in-depth training of undergraduate and graduate students of three engineering disciplines (mechanical, electrical/electronics, and computer engineering majors) on various aspects of mechatronic systems, including hydrostatic transmission and control. Dr. Anwar's research and teaching experience would greatly help in the proposed project through utilization of his expertise in hydrostatic drivetrain design and testing as well as its control.
3. Dr. Anwar has over twenty eight years of research and teaching experience in the area of Mechatronics System and Control. He has published over 120 technical papers and presented lectures at various national and international conferences. Dr. Anwar is also the inventor of 14 US patents. He is the recipient of many external research grants from the industry, the state, and federal agencies (Cummins, Inc., Delphi Corp., Servo Tech, Inc., Indiana Office of Energy and Defense Developments, US Dept. of Energy, National Science Foundation). He is also pursuing active research in these areas at the Mechatronics Research Lab. He is a member of ASME, IEEE, and the faculty advisor for the SAE student chapter at IUPUI. Dr. Anwar is an Associate Editor of *IEEE Trans. on Vehicular Technology* and *SAE Trans. on Passenger Cars – Electrical Systems*, and *Int'l J. Modeling and Simulation*. He also serves as a reviewer for a number of domestic and international journals and conference proceedings, as well as proposal reviewer for US DoE, NSERC (Canada), ARPA-E.
4. Dr. Anwar is the recipient of the prestigious "Research Initiative Award" from Purdue School of Engineering and Technology, IUPUI for his initiative to secure industry grants. He was also nominated for "Student Supervisor of the Year" at IUPUI for his support of graduate students.
5. Dr. Anwar led the project on developing an optimally designed plug-in hybrid electric vehicle (PHEV) powertrain at IUPUI in 2008. It was funded by the State of Indiana for which Dr. Anwar was the PI. He, along with the Co-PI form ECE department, formed an interdisciplinary team of graduate students from both Mechanical Engineering and Electrical/Computer Engineering majors to complete the design and build of two prototype vehicles by the project deadline. He also led the development of a driving simulator designed to evaluate the performance of drive-by-wire systems at the Ford Motor Company (later Visteon Corp). Dr. Anwar received nomination for Visteon's prestigious award "Leading the Way" for his effort in developing the driving simulator in 2003.

Collaborators & Other Affiliations

- **Collaborators (8):** 1. Prof. Jie Chen, IUPUI. 2. Prof. Yaobin Chen, IUPUI. 3. Prof. Andrew Hsu, Univ of Toledo. 4. Prof. Sabri Cetinkunt, Univ of Illinois Chicago, IL. 5. Prof. Hiroki Yokota, IUPUI. 6. Prof. Stanley Chien, IUPUI. 7. Dr. M. Terry Loghmani, IUPUI. 8. Prof. Alan Sawchuk, IUPUI.
- **Co-Editors (4):** 1) *IEEE Transactions on Vehicular Technology;* 2) *SAE Transactions – Journal of Passenger Vehicles; 3) Int'l J. Modeling and Simulation*; *and 4) Adv. Auto. Eng.*
- **Graduate and Postdoctoral Advisors (2):** 1. Prof. Abhijit Chandra, Dept. of Mechanical Eng., Iowa State University, Ames, IA. 2. Dr. Patrick Hollis, Assoc. Prof., Dept. of Mechanical Eng., Florida State University, Tallahassee, FL.
- **Thesis Advising and Postgraduate-Scholar Sponsor (28)**: B. Snyder, Y. Lin, D. Reyhart, M.S. Hasan, Dr. H. Banvait, W. Niu, U. Tugsal, E. Yildiz, Q.R. Farooqi, D. Fitzwater, S. Hamzehlouia, A. Pusha, Dr. M. Deldar, R. Huq, A. Singh, M. Vaezi, B. Patel, V.K.S. Muddappa, S. Pramanik, M.A. Rahman, A. Alotaibi, Ammar E. Ali, A.C. Shekar, M.N. Khan, S.K. Prabhala, S. Korupolu, S.K. Panda, Dr. Z. Liu.

Jie Chen, Ph.D.
Indiana University Purdue University Indianapolis

A. Education and Training

BS in Mechanical Engineering, Tianjin University, Tianjin, P.R. China, 1982

MS in Biomedical Engineering, Shanghai 2nd Medical University, Shanghai, China, 1984

Ph.D. in Mechanical Engineering, Drexel University, Philadelphia, PA, 1989

B. Professional Experience

2008-present	Chair of Department of Mechanical Engineering, Indiana University Purdue University Indianapolis (IUPUI)
2000-present	Professor of Mechanical Engineering, IUPUI
2000-present	Professor of Orthodontics and Oral Facial Genetics, IU
2000	Senior Training Specialist, Ford Motor Company (one-year sabbatical leave)
1997-1999	Acting Chair of Department of Mechanical Engineering, IUPUI
1995-2000	Associate Professor of Mechanical Engineering, IUPUI
1995-2000	Associate Professor of Orthodontics and Oral Facial Genetics, IU
1990-1995	Assistant Professor of Mechanical Engineering, IUPUI
1990-1996	Assistant Professor of Orthodontics and Oral Facial Genetics, IU
1989-1990	Postdoctoral Fellow, Dept. of Mechanical Engineering, Drexel University

C. Selected peer-reviewed publications

Five publications most related to the proposed project

Zhang, D., Chen, J., Hsieh, T., Rancourt, J., and Schmidt, M.R., "Dynamic modeling and simulation of two-mode electric variable transmission" Proc Instn Mech Engrs, Vol 215, pp. 1217-1223, 2001

Zhang, D., Chen, J., Hsieh, T., Rancourt, J., and Schmidt, M.R., "Dynamic modeling and simulation of one- and three- mode electric variable transmission" International Journal of Vehicle Design, Vol. 35, Issue 3, 241-273, 2004

Cao, M. and Chen, J. "HEV Maximum Power Performance Simulation and Duty Cycle Generation" Int. J. Vehicle Design, Vol. 38, 42 No. 1, 2005

Chen, J., Bai, G., Shen, Z., Li, X., Fulton, D., Hsu, A. "Prediction of Failure Rate of Rotary Machine Using Computer simulations," the ASME Transaction Journal of Manufacturing Science and Engineering, Vol. 127, No 4, 768-772, 2005

Chen, J. and Akay H.U., Capstone Design Course – *A Bridge to the Real World Engineering*, National Capstone Design Course Conference-2007, Boulder, Colorado, 6/13-6/15/07

Five most recent publications

Xia, Z., Jiang, F., and Chen, J. "Estimation of Periodontal Ligament's Equivalent Mechanical Parameters for Finite Element Modeling" American Journal of Orthodontics and Dentofacial Orthopedics, Volume 143, Issue 4, Pages 486-91, 2013

Xia, Z., Chen, J., Jiang, F., Li, S., Viecilli, R.F., and Liu, S., "Load System of Segmental T-Loops for Canine Retraction" the American Journal of Orthodontics and Dentofacial Orthopedics, 2013 Oct;144(4):548-56

Xia, Z., Chen, J., "Biomechanical Validation of an Artificial Tooth-PDL-Bone Complex for in vitro Orthodontic Load Measurement" Angle Orthodontists, 2013;83(3):410-7

Mittal, N., Xia, Z, Chen, J., Stewart, K.T., and Liu, S.S., "Three-dimensional quantification of pre-torques nickel-titanium wires in edgewise and prescription brackets" Angle Orthodontists 2013; 83(3):484-90

Katona, T, Isikbay, S. and Chen, J. "Effects of 1st and 2nd order gable bends on the 3D orthodontic load systems produced by T-loop archwires" Accepted by the Angle Orthodontists, 7/2013

Patent

Chen, J. Apparatus and method for measuring orthodontic force applied by an orthodontic appliance. US patent # 6,120,287

Xie, J., Chen, J., Li, L., and Chen, Y., Battery early warning and monitoring system, US patent #8,952,823

D. Synergistic Activities

1. Served as the PI for the project ($2.5M), "Lithium-Ion Battery Safety Project" sponsored by the Navy

This was a completed project that aimed at developing an early failure warning system for lithium-ion battery packs. I worked with a group of faculty, postdocs and students in IUPUI and engineers in Delphi Corporation to systematically study the behavior of Li-ion battery, to test battery under various hazardous conditions, to define the state of health, and to build a system that would be able to provide an early warning with acceptable probability.

2. Served as the PI for multiple industrial projects ($290K)

Have been working with industries on research projects, which lead to new technologies for treating orthodontic patients.

3. Serve as the Director of the Indiana Industrial Assessment Center sponsored by DOE ($2.8M)

I established the center to train next generation energy efficient workforce at various levels, certificate, BS, and graduate. Students do hands-on industrial assessment and go through an energy management curriculum. They benefit from direct interaction with engineers and customers; and apply their training to solve real world engineering problems.

4. Curriculum Development

During my tenure as the chair, my department has developed a new degree program, Bachelor of Science in Energy Engineering. The program received approvals from the Indiana Commission of Higher Education and started in 2010. The goal was to train next generation of energy engineers.

5. Rapid Growth of our department

I have experience to lead my department that has been experiencing with a rapid growth during my tenure as the department chair. The undergraduate credit hours increased from 3,800 in 2008 to 12,000 (200% increase) in 2017; the graduate credit hours increased from 489 in 2008 to 3,065 (526% increase) in 2017.

E. Collaborators & Other Affiliations

Collaborators and co-editors
Dr. Sean Liu, Indiana University; Zeyang Xia, Shenzhen Institute of Advanced Technology; Greg Simopoulos, Delphi Automotive; David Delafuente, Crane Naval Surface of Warfare Center
Graduate Advisors and Postdoctoral Sponsors
Dr. Sorin Siegler, Drexel University
Thesis Advisor and Postgraduate Scholar Sponsor
Shuning Li, Indiana University; Feifei Jiang, Ph.D. candidate; Yunfeng Liu, Postdoc, Zhejiang Institute of Technology, China; Zeyang Xia, Postdoc, Shenzhen Institute of Advanced Technology

HAMID DALIR, Ph.D.
Associate Professor
Department of Mechanical Engineering | Motorsports Engineering
Purdue School of Engineering and Technology, IUPUI
799 W. Michigan Street, ET 201F
Indianapolis, IN 46202-5160, United States
T – 317-278-4430 E – hdalir@iupui.edu
W – http://www.engr.iupui.edu/main/people/detail.php?id=hdalir

CURRENT POSITIONS

08/2017-Now **Associate Professor**
Purdue School of Engineering and Technology, IUPUI, IN, USA.
Department of Mechanical Engineering | Motorsports Engineering
Director of Advanced Composite Structures Engineering Laboratory (ACSEL)
Courses being taught: Statics and Dynamics (MSTE 21000); Dynamic Systems and Signals (MSTE 34000)

EDUCATION

04/2006-08/2009 **Doctor of Philosophy, Mechanical Engineering**
Tokyo Institute of Technology, Tokyo, Japan
Nature of research: Probing mechanical characteristics of biomaterials using layered manipulators

10/2003-11/2005 **Master of Science, Mechanical Engineering**
Sharif University of Technology, Tehran, Iran
Nature of research: Frequency analysis of embedded carbon fibers in composites during ultrasound cure

10/1999-07/2003 **Bachelor of Science, Mechanical Engineering**
Ferdowsi University of Mashhad, Mashhad, Iran
Nature of research: Modal analysis of power plant rotating shafts by distributed-lumped modeling technique

RESEARCH INTERESTS

- Stress, vibration, modal and thermal analysis
- Computational mechanics
- Multi-disciplinary design optimization
- Composite materials and damage mechanics
- Multi-scale modeling and material characterization
- Material constitutive relations and modeling

TEACHING INTERESTS

- Statics | Dynamics | Mechanical vibrations
- Mechanics of materials | Mechanical behavior of polymer composite materials
- Machine element design | Stress and failure analysis of machinery
- Finite element analysis
- Design and analysis of aerospace structures | Aircraft stress analysis
- Capstone mechanical/aerospace engineering design project

SPONSORED RESEARCH

01/2016-08/2017 **AM-TEC Analysis and Design Center**
The New York State Energy Research and Development Authority (NYSERDA), New York, USA.
Projects under my supervision:

- "Minimization of PT-410 cryostat vibrations under impulsive pressure", CryoMech inc. (www.cryomech.com), New York, USA.
- "Prediction of residual stresses and shape distortions of composite parts", Bombardier Aerospace inc. (www.bombardier.com), Quebec, Canada.
- "Walking plank optimization of an in-house designed cleanroom during maintenance", SBB inc. (www.sbbinc.com), New York, USA.
- "Thermoelastic verification of a pressurized steam boiler vessel", Fulton boilers inc. (www.fulton.com), New York, USA.
- "Damage tolerance verification of a casted pressurized vessel", Fulton Boilers inc. (www.fulton.com), New York, USA.
- "Optimization of a pressurized incubator door", SBB inc. (www.sbbinc.com), New York, USA.
- "Design and automation of a depaneling machine for sizing circuit boards", ICM Controls inc. (www.icmcontrols.com), New York, USA.

PREVIOUS POSITIONS: RESEARCH & INDUSTRIAL

08/2015-8/2017 **Associate Professor**
Syracuse University, New York, USA.
Department of Mechanical and Aerospace Engineering
Courses taught: Design and Analysis of Aerospace Structures (AEE 471); Finite Element Analysis (MAE 573); Synthesis of Aerospace Systems (AEE 472); *Courses co-taught:* Engineering Computational Tools (ECS 104); Engineering Graphics and Computer-Aided Design (MAE 184)

09/2011-08/2015 **Airframe Structures Specialist**
Bombardier Aerostructures and Engineering Services, Montreal, Canada.
Department of Advanced Structures

Responsibilities:
- Coordination of Bombardier-University projects in aerospace structural analysis, design and manufacturing.
- Certification testing of metallic and composite design features for aircraft parts and components.
- Finite Element Analysis (FEA) and Margin of Safety (MOS) evaluation of aircraft parts and components.

09/2009-08/2011 **Postdoctoral Researcher**
Polytechnique Montreal, Canada
Department of Mechanical Engineering
Nature of work: Modeling and analysis of the mechanical, thermal and barrier properties of nanocomposites

10/2006-12/2008 **Research Engineer**
Japan Society for the Promotion of Sciences, Tokyo, Japan
Engineering Innovation through Development of Advanced Robotics, 21st Century COE Program
Nature of work: Design and control of a hexapod wall jumping robot for cleaning skyscrapers

04/2006-08/2009 **Research Assistant**
Tokyo Institute of Technology, Tokyo, Japan
Department of Mechanical Engineering, Precision and Intelligence Laboratory
Nature of work: Probing mechanical characteristics of biomaterials using layered manipulators

PREVIOUS POSITIONS: TEACHING

01/2013-05/2015 **Adjunct Professor**
Polytechnique Montreal, Canada.
Department of Mechanical Engineering
Taught: Strength of Aircraft Structures (AER2400)

04/2009-08/2009 **University Lecturer**
Tokyo Institute of Technology, Tokyo, Japan
Department of Mechanical Engineering
***Taught*:** Engineering Mathematics (MME110)

01/2007-12/2007 **Teaching Assistant**
Tokyo Institute of Technology, Tokyo, Japan
Department of Mechanical Engineering
***Assisted in teaching*:** Vibration, Control, and Robotics

AWARDS & PROFESSIONAL SERVICE

05/2016 **2016 Outstanding L.C. Smith Faculty Excellence Award**,
College of Engineering and Computer Science, Syracuse University, New York, USA.

07/2016 **2016 IEEE Best Paper Award**,
IEEE International Conference on Mechanical and Aerospace Engineering (ICMAE 2016), London, UK.

06/2016-08/2017 **SyracuseCoE Faculty Fellow,**
The New York State Energy Research and Development Authority (NYSERDA), New York, USA.

07/2016 **IEEE Technical Committee Member, and Materials & Design Session Chair**,
IEEE International Conference on Mechanical and Aerospace Engineering (ICMAE 2016), London, UK.

09/2016 **American Society for Composites (ASC) Technical Advisor, Organizing Committee Member, and Manufacturing & Processing Session Chair**, American Society for Composites 31 Technical Conference and ASTM Committee D30 Meeting, Williamsburg, Virginia, USA.

09/2009-08/2011 **Postdoctoral Fellowship Award**,
Research Center for High Performance Polymer and Composite Systems (CREPEC)

09/2009-08/2011 **Postdoctoral JSPS Fellowship Award, Declined the Award in favor of CREPEC**
Japan Society for the Promotion of Sciences (JSPS)

2010 **NAMIS Best Presentation Award (Gold Prize)**
NAMIS International School 2010, Institute of Industrial Science, University of Tokyo

04/2006-09/2009 **Doctoral Fellowship Award, Monbukagakusho (Government of Japan)**
Ministry of Education, Science and Technology (MEXT) of Japan

01/2007-12/2007 **21st Century COE Sponsored Research Award**
Japan Society for the Promotion of Sciences (JSPS)

2008 **Outstanding Project Leadership Award**
Tokyo Institute of Technology, Tokyo, Japan

MEMBERSHIPS

- American Society of Mechanical Engineers (ASME)
- American Institute of Aeronautics and Astronautics (AIAA)
- American Society of Composites (ASC)
- AESS (IEEE) Aerospace & Electronic Systems Society

- Materials Research Society (MRS)
- Japan Society for Precision Engineering (JSPE)
- Japanese Society of Applied Physics (JSAP)

EDITORIALS
Reviews for:

- Journal of Aircraft – AIAA
- Composite Science and Technology – Elsevier
- Sensors and Actuators B – Elsevier
- Molecular Simulation – Taylor & Francis
- Langmuir – ACS Publications
- Computational Mechanics – Springer

SOFTWARE KNOWLEDGE

NASTRAN/PATRAN, ABAQUS, HyperMesh, ANSYS, CATIA, MATLAB, Visual Basic

PUBLICATIONS

Submitted or ready-to-submit manuscripts awaiting industrial partner's approval

1. H. Tian, X. Cao, C. Wang and **H. Dalir**, "Vibration and noise reduction of a commercial 4^{o}K pulse-tube Cryocooler", ***Cryogenics***, Elsevier, awaiting industrial approval.

2. D. Barry, **H. Dalir** and S. Joncas, "Design and optimization of an aircraft morphing wing: metallic structure and actuators", ***AIAA Journal***, awaiting industrial approval.

Peer-reviewed published Journal articles

1. F. Michaud, **H. Dalir** and S. Joncas, "Structural design and optimization of an aircraft morphing wing: Composite skin", ***AIAA Journal*** (2017), accepted for publication (available online), DOI 10.2514/1.C034340, pp. 1-17.

2. **H. Dalir**, R. D. Farahani, L. Hernandez, C. Aldebert, M. Lévesque and D. Therriault, "Three-dimensional dielectrophoretic microparticle separator fabricated by ultraviolet-assisted direct-write assembly", ***Journal of Nanoscience and Nanotechnology*** **16** (2016), pp. 765-771.

3. R. D. Farahani, M. Pahlavanpour, **H. Dalir**, B. Aissa, M. A. E. Khakani, M. Lévesque, and D. Therriault, "Flow-induced orientation of functionalized single-walled carbon nanotubes embedded in epoxy using three-dimensional microfluidic networks", ***Materials and Design*** **41** (2012), pp. 214-225.

4. R. D. Farahani, **H. Dalir**, V.L. Borgne, L. A. Gautier, M. A. E. Khakani, M. Lévesque, and D. Therriault, "Reinforcing epoxy nanocomposites with functionalized carbon nanotubes via biotin-streptavidin interactions", ***Composites Science and Technology*** **72** (2012), pp. 1387-1395.

5. **H. Dalir**, R. D. Farahani, V. Nhim, B. Samson, M. Lévesque and D. Therriault, "Preparation of highly exfoliated polyester-clay nanocomposites: process-property correlations", ***Langmuir*** **28** (2012), pp. 791-803.

6. R. D. Farahani, **H. Dalir**, V.L. Borgne, L. A. Gautier, M. A. E. Khakani, M. Lévesque, and D. Therriault, "Direct-write fabrication of freestanding nanocomposite strain sensors", ***Nanotechnology*** **23** (2012), pp. 1-9. Featured on the cover page of the Journal published on the March 2, 2012.

7. **H. Dalir**, R. D. Farahani, V. Nhim, B. Samson, M. Lévesque and D. Therriault, "Microstructural and Mechanical Properties of Polyester/Nanoclay Nanocomposites: Microstructure-Mixing Strategy Correlation", ***Material Research Society*** **1312** (2011), ii02-05 (9 pages).

8. R. D. Farahani, **H. Dalir**, Brahim Aissa, My Ali El Khakani, Martin Lévesque and Daniel Therriault, "Micro-infiltration of three-dimensional porous networks with carbon nanotube-based nanocomposite for material design", ***Composites Part A*** **42** (2011), pp. 1910-1919.

9. **H. Dalir**, T. Nisisako, Y. Yanagida, and T. Hatsuzawa, "DNA force-extension curve under uniaxial stretching", ***Molecular Simulation*** **36** (2009), pp. 221-228.

10. **H. Dalir**, Y. Yanagida, and T. Hatsuzawa, "Probing DNA mechanical characteristic by dielectrophoresis", ***Sensors and Actuators B*** **136** (2009), pp. 472-478.

11. **H. Dalir**, Y. Yanagida, and T. Hatsuzawa, "Multipolar electrical forces for microscale particle manipulation", ***Journal of Computational and Theoretical Nanoscience*** **6** (2009), pp. 505-513.

12. **H. Dalir**, S. Shayan Amin, and A. Farshidianfar, "Effects of Small length scale on vibrations of an embedded double-walled carbon nanotube", ***Mechanics of Composite Materials*** **45** (2010), pp. 557-566.

13. S. Shayan Amin, **H. Dalir**, and A. Farshidianfar, "Carbon nanotube reinforced Composites: frequency analysis theories based on the matrix stiffness", ***Computational Mechanics*** **43** (2009), pp. 515-524.

14. M. H. Mahdavi, A. Farshidianfar, M. Tahani, S. Mahdavi and **H. Dalir**, "A more comprehensive modeling of atomic force microscope cantilever", ***Ulramicroscopy*** **109** (2008), pp. 54-60.

15. S. Shayan Amin, **H. Dalir**, and A. Farshidianfar, "Molecular dynamics simulation of double-walled carbon nanotube vibrations: comparison with continuum elastic therories", ***Journal of Mechanics*** **25** (2009), pp. 279-285.

16. M. H. Mahdavi, A. Farshidianfar, and **H. Dalir**, "Flextural vibration of atomic force microscope cantilever with tip effects", ***Amirkabir Journal of Science and Technology*** **41** (2009), pp. 19-26 (in farsi).

Conference papers

1. ***H. Dalir**, "Damage tolerance coupon sizing of composite stiffened panels under impact", ***IEEE International Conference on Mechanical and Aerospace Engineering (IEEE ICMAE 2016)***, pp. 68-72., July 18-22, 2016, London, UK.

2. X. Cao, H. Tian and ***H. Dalir**, "Development of a new finite element simulation strategy for prediction of thermal and resin shrinkage deformations of composite parts during cure", ***American Society for Composites 31 Technical Conference and ASTM Committee D30 Meeting (ASC 2016)***, Sep. 19-22, 2016, Virginia, USA.

3. ***H. Dalir**, J. E. Brunel, and A. Landry, "Spring-in predictions of angled composite parts", ***Canadian - International Conference on Composites (CANCOM 2015)***, August 18-20, 2015, Edmonton, Canada.

4. ***H. Dalir**, J. E. Brunel, F. Dervault, and A. Landry, "Stiffness evaluation of the composite laminates with wavy plies and their stability analysis", ***The 19th International Conference on Composite Materials (ICCM 19)***, July 28-August 2, 2013, Montreal, Canada.

5. J. C. S. Marc, **H. Dalir**, J. E. Brunel, and F. Dervault, "Part redesign: from fastened assembly to co-cured concept", ***SAE AeroTech Congress & Exhibition (SAE 2013)***, September 24-26, 2013, Montreal, Canada.

6. ***H. Dalir**, R. D. Farahani, V. Nhim, B. Samson, M. Lévesque, and D. Therriault, "Mixing strategy effects on physical properties of nanoclay nanocomposites", ***The Second Joint US-Canada conference on composites (CACSMA 2011)***, September 26-28, 2011, Montreal, Canada.

7. ***H. Dalir**, R. D. Farahani, M. Lévesque and D. Therriault, "UV-assisted direct-write assembly of scaffold-templated nanoclay composites via biotin-streptavidin interactions", ***ASME International Mechanical Engineering Congress & Exposition (ASME 2010)***, November 12-18, 2010, Vancouver, Canada.

8. *__H. Dalir__, M. Lévesque and D. Therriault, "Direct-write assembly of microstructures", ***NAMIS International Autumn School 2010 (NAMIS 2010)***, October 17-23, 2010, Tokyo, Japan. (won the best poster presentation award)

9. *__H. Dalir__, V. Nhim, B. Samson, M. Lévesque and D. Therriault, "Study of the structural and mechanical properties of polyester/nanoclay nanocomposites: structure-mixing strategy correlation", ***Materials Research Society (MRS 2010)***, November 29-December 3, 2010, Boston, Massachusetts, USA.

10. R. Farahani, __H. Dalir__, M. Lévesque and D. Therriault, "Mechanical properties of three-dimensional microstructures infiltrated by carbon nanotube/epoxy nanocomposite under shear flow", ***ASME International Mechanical Engineering Congress & Exposition (ASME 2010)***, November 12-18, 2010, Vancouver, Canada.

11. *__H. Dalir__, Y. Yanagida and T. Hatsuzawa, "Dielectrophoretic characterization of DNA elastic properties", ***Nanotech Insight 2009***, March 29-April 2, 2009, Barcelona, Spain.

12. *__H. Dalir__, T. Nisisako, Y. Yanagida and T. Hatsuzawa, "DNA mechanical properties: formulation and comparison with experiments", ***7th International Conference on Computational Nanoscience and Nanotechnology (ICCN 2008)***, June 1-5, 2008, Boston, Massachusetts, USA.

13. __H. Dalir__, T. Nisisako, T. Endo, Y. Yanagida and T. Hatsuzawa, "Limitations of DNA high-frequency anchoring and stretching", ***7th International Conference on Computational Nanoscience and Nanotechnology (ICCN 2008)***, June 1-5, 2008, Boston, Massachusetts, USA.

14. *__H. Dalir__, Y. Yanagida and T. Hatsuzawa, "Dielectrophoretic analysis of DNA elasticity", ***The Third International Conference on Positioning Technology***, November 26-28, 2008, Hamamatsu, Japan.

15. *__H. Dalir__, T. Hatsuzawa, J. Akbari, "Effects of axial load on wave propagation in double-walled carbon nanotubes used as a flexible tip in AFM", ***Annual meeting of the Japan Society for Precision Engineering***, September 20-22, 2006, Utsunomiya, Japan.

16. *__H. Dalir__, T. Nisisako, T. Endo, Y. Yanagida and T. Hatsuzawa, "DNA dielectrophoresis: voltage- and frequency-dependent immobilization", ***Annual meeting of the Japan Society for Precision Engineering***, March 17-19, 2008, Tokyo, Japan.

17. *__H. Dalir__, Y. Yanagida and T. Hatsuzawa, "Quadrupolar analysis of an interdigitated micro-electrode array for dielectrophoretic particle transport", ***Annual meeting of the Japan Society for Precision Engineering***, September 17-19, 2008, Shizuoka, Japan.

18. __H. Dalir__, J. Akbari, T. Hatsuzawa and A. Farshidianfar, "Effects of axial load on wave propagation in double-walled carbon nanotubes used as a tip in AFM", ***ASME International 20th Biennial conference on Mechanical Vibration and noise***, September 24-28, 2005, Long Beach, California, USA.

19. *__H. Dalir__, T. Hatsuzawa, "Frequency investigation of a contact atomic force micro-cantilevers", ***3rd Tokyo Tech-KAIST Joint Workshop***, Feb 2007, Tokyo, Japan.

20. *__H. Dalir__, S. Hirose, T. Tanaka, N. Matsuhira, "Design of a jumping window cleaning robot", ***4th COE Symposium on Robotics***, Mar 2007, Hiroshima, Japan.

21. T. Tanaka, __H. Dalir__, K. Hirokawa, S. Hirose, "Development of wall jumping mobile robot", ***The 25th Annual Conference of the Robotics Society of Japan***, September 13-15, 2007, Chiba, Japan.

22. S. Shayan amin, A. Farshidianfar and __H. Dalir__, "Timoshenko frequency analysis of carbon nanotubes using as fibers in composite materials", ***3rd International Congress of Nanotechnology (ICNT 2006)***, October 30-November 2, 2006, San Francisco, USA.

23. M. Mahdavi, A. Farshidianfar, M. Tahani and __H. Dalir__, "Frequency analysis of atomic force microscopy cantilevers in a dynamic mode considering tip mass and moment of inertia", ***3rd International Congress of Nanotechnology (ICNT 2006)***, October 30- November 2, 2006, San Francisco, USA.

24. A. Farshidianfar, **H. Dalir**, "Distributed-lumped modeling technique usage in engineering vibration problems", ***Twelfth International Congress on Sound and Vibration***, July 11-14, 2005, Lisbon, Portugal.

25. *__H. Dalir__, A. Farshidianfar, S. Shayan Amin, "Frequency response of longitudinal vibration using distributed – lumped modeling technique", ***International Mechanical Engineering Conference (IMEC2004)***, December 5-8, 2004, Kuwait.

26. M. Mahdavi, A. Farshidianfar, **H. Dalir** and S. Mahdavi, "Wave propagation in multi-walled carbon nanotubes under axial load using timoshenko noncoaxial beam theory", ***ASME Applied Mechanics and Materials Conference (MACMAT 2007)***, June 3-7, 2007, Texas, USA.

27. A. Farshidianfar, *__H. Dalir__, M. Mahdavi, S. Shayan amin "Modal analysis of shirvan's gas turbines using distributed-lumped modeling technique", ***12th International Conference of Mechanical Engineering***, May 2004, Tehran, Iran.

28. A. Farshidianfar, *__H. Dalir__, "Frequency investigation of modified crank shaft of peykan RD", ***11th International Conference of Mechanical Engineering***, May 2003, Tehran, Iran.

29. A. Farshidianfar, *__H. Dalir__, S. Shayan amin, "Frequency investigation of rotating rotor's torsional vibration using hybrid modeling technique", ***6th International Conference of Manufacturing Engineering***, May 2003, Tehran, Iran.

30. *__H. Dalir__, A. Farshidianfar, "Flexural vibration of rotating shafts by frequency domain hybrid modeling", ***12th International Conference of Mechanical Engineering***, May 2004, Tehran, Iran.

31. **H. Dalir**, A. Farshidianfar, S. Shayan amin, M. Mahdavi , "An approach to the elastic column buckling with allowance for shear deformation and rotary inertia", ***14th International Conference of Mechanical Engineering***, May 2006, Isfahan, Iran.

32. M. Mahdavi, A. Farshidianfar, **H. Dalir**, S. Shayan amin, "High frequency analysis of a non-contact atomic force microscopy microcantilever", ***14th International Conference of Mechanical Engineering***, May 2006, Isfahan, Iran.

33. V. Rahimi, **H. Dalir**, M. Faghihi Sani, Z. Nemati, J. Akbari, "Microstructure and cutting performance investigation of Ti(CN)-Based cermets containing various types of secondary carbides", ***Tehran International Congress on Manufacturing Engineering (TICME2005)***, December 12-15, 2005, Tehran, Iran.

34. M. H. Mahdavi, A. Farshidianfar and **H. Dalir**, "High frequency analysis of a non-contact atomic force microscope considering the mass and rotary inertia", ***15th International Conference of Mechanical Engineering***, May 2007, Tehran, Iran.

35. A. Farshidianfar, S. Shayan Amin and **H. Dalir**, "Carbon nanotube frequency analysis theories considering the effects of rotary inertia and shear deformation", ***The Third International Conference on Positioning Technology***, November 26-28, 2008, Hamamatsu, Japan.

** Indicates presentation by* ***H. Dalir****.*

Hazim El-Mounayri, Ph.D.
Associate Professor,
Department of Mechanical Engineering,
Purdue School of Engineering and Technology,
IUPUI, IN

Professional Preparation:

American U. in Cairo, Cairo, Egypt	Mechanical Engineering	B.S.	1989
American U. in Cairo, Cairo, Egypt	Mechanical Engineering	M.S.	1992
McMaster University, ON, Canada	Mechanical Engineering	Ph.D.	1997

Appointments:

2003-present	Associate Professor, Mechanical Engineering Department, IUPUI, Indianapolis, IN
2013-present	Director of IPLI (Initiative for Product Lifecycle Innovation), IUPUI, IN
2015-present	Co-director of MDL (Multibody Dynamics Lab), IUPUI, IN
1998-present	Co-director of AEML (Advanced Engineering and Manufacturing Lab), IUPUI
2011-present	Senior Research Consultant for Advanced Manufacturing applications & e-learning, Asciencetutor
2004-2010	Senior Research Scientist/Consultant for Manufacturing Applications, Advanced Science and Automation Corp.
2008-2010	Graduate Chair of Mechanical Engineering, IUPUI
1997-2003	Assistant Professor, Mechanical Engineering Department, IUPUI, IN
1996-1997	Research Assistant, McMaster University, ON, Canada
1992-1996	Research/Teaching Assistant, IMMRC, McMaster University, ON, Canada

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Selected Honors and Awards:

2010	Teaching Excellence Recognition Award, IUPUI, IN
2008	TRIP (Translating Research Into Practice) scholar, IUPUI, IN
2008	Teaching Excellence Recognition Award, IUPUI, IN
2001-2002	Trustees Teaching Award, IUPUI, IN
2000	Teaching Excellence Recognition Award, IUPUI, IN

Five Relevant Publications:

1. Ehsan Malekipour, Hazim El-Mounayri, "Common Defects and Contributing Parameters in Powder-based AM Process and Their Classification for Online Monitoring- A Review", Journal of Additive Manufacturing (in press)
2. Rapeepan Promyoo, Hazim El-Mounayri, Mangilal Agarwal, Varun K Karingula, Kody Varahramyan, TIP-BASED NANOMANUFACTURING (TBN) OF NANOFLUIDICS USING AFM, ASME Journal of Micro and Nano Manufacturing, vol. 4, pp. 041003-1 to 041003-7, August 2016.
3. Tushar Bakhtiani, Hazim El-Mounayri and Jing Zhang, Modeling and simulation of extrusion process of a condenser tube for optimizing the mandrel geometry, International Journal of Advanced Manufacturing Technology, (DOI 10.1007/s00170-017-0374-2), 2017
4. Suchana A. Jahan, Tong Wu, Yi Zhang, Jing Zhang, Andres Tovar, and Hazim El-Mounayri, " Thermo-mechanical Design Optimization of Conformal Cooling Channels using Design of Experiments Approach", Procedia Manufacturing, 2017.
5. Wou, J.; Shin, Y.; El-Mounayri, H.; Ball End Milling Mechanistic Model based on a Voxel-based Geometric Representation and a Ray Casting Technique, Journal of Manufacturing Processes, 15 (3): 338–347, 2013.

Five Other Products:

1. H. El-Mounayri, J. Briceno, and M. Gadallah, "A New Artificial Neural Network Approach to Modeling Ball-End Milling", I J of Advanced Manufacturing Technology, Volume 47, Issue 5, pp 527-534, 2010
2. Hazim El-Mounayri and Haiyan Deng, "A Generic and Innovative Approach for Integrated Simulation and Optimization of End Milling using Solid Modeling and Neural Network", International Journal of Computer Integrated Manufacturing, Volume 23, Issue 1 January 2010 , pages 40 – 60.
3. H. El-Mounayri, M. A. Badar, G. A. Rengifo, "Multi-parameter ANN model for flat-end milling", Transactions of the CSME, Volume 32, Issue #3-4, pp 523-536, 2008.
4. Rapeepan Promyoo, Hazim El-Mounayri and Kody Varahramyan "A Study of AFM-Based Nanoindentation using a 3D Molecular Dynamics Simulation Model"; Journal of Materials Science and Engineering, A 3 (6) (2013) 369-381.
5. H. El-Mounayri, H. Kishawy & J. Briceno, "Optimization of CNC Ball End Milling: A Neural Network-based Model", Journal of Materials Processing Technology, 166 (2005) 50-62.

Synergistic Activities:

- Establishment of IPLI (Initiative for Product Lifecycle Innovation), a center and consortium, to advanced product lifecycle and promote and educate students/workforce on best practice in Systems driven model based product development, and MBSE (Model-based Systems Engineering).
- (Co-) Development of the Advanced Virtual Manufacturing Lab (AVML) and the Virtual Learning Environment for University Physics.
- Development of innovative modeling and optimization tools for manufacturing applications using Artificial Intelligence and Evolutionary computation techniques.
- Development of online course for teaching advanced manufacturing to high school students.

Biographical Sketch for Alan S. Jones

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(a) Professional Preparation

Bradley University	Peoria, IL	Mechanical Engineering	B.S. 1994
University of Michigan	Ann Arbor, MI	Mechanical Engineering	M.S. 1995
University of Michigan	Ann Arbor, MI	Mechanical Engineering	Ph.D. 2003
University of Illinois	Champaign, IL	Aerospace / Mechanics	Postdoc 2003-2005

(b) Appointments

2014 – Present	Head of Mechanical Engineering Program, IUPUC
2013 – Present	Associate Chair, Department of Mechanical Engineering, IUPUI
2011 – Present	Associate Professor, Department of Mechanical Engineering, IUPUI
2010 – 2011	Interim Director, Richard G. Lugar Center for Renewable Energy
2005 – 2011	Assistant Professor. Department of Mechanical Engineering, IUPUI
1995 – 1998	Polymer Team Lead & Design Engineer, Advanced Optics and Materials Laboratory, Texas Instruments / Raytheon T.I. Systems, Dallas, TX

(c) Products

PUBLICATIONS MOST CLOSELY RELATED

1. A. Jones, M. Golub, "Effectiveness of Current Generation Virtual Reality Based Laboratories", ASEE Annual Conference & Exposition, Salt Lake City, UT, June 24-27, 2018. (Accepted)

2. A. Jones, "Evaluation of Canvas Based Online Homework for Engineering", ASEE Annual Conference & Exposition, Columbus, OH, June 25 – 28, 2017.

3. E.M. Fayyad, M.A. Almaadeed, A. Jones, Encapsulation of Tung Oil for Self-Healing Coatings in Corrosion Applications. *Science of Advanced Materials*, 7(12), 2628-2638, 2015. Doi:10.1166/sam.2015.2583

4. E.M. Fayyad, M.A. Almaadeed, A. Jones, Preparation and characterization of urea-formaldehyde microcapsules filled with paraffin oil, *Polymer Bulletin*, 1-16, 2015. doi:10.1007/s00289-015-1518-x

5. E.M. Fayyad, M.A. Almaadeed, A. Jones, A.M. Abdullah, Evaluation Techniques for the Corrosion Resistance of Self-Healing Coatings, *International Journal of Electrochemical Science, 9, 4989-5011, 2014.*

OTHER SIGNIFICANT PUBLICATIONS

6. A. S. Jones, H. Dutta, Fatigue Life Modeling of Self-Healing Polymer Systems, *Mechanics of Materials*, 42 (4), 481-490, 2010.

7. Diouf, P. and Jones, A., Investigation of bond strength in centrifugal lining of Babbitt on cast iron, *Metallurgical and Materials Transactions A*, 41 (3), 603-609, 2010.

8. Jones, A.S., Rule, J.D., Moore, J.S., Sottos, N.R., White, S.R. Life extension of self-healing polymers with rapidly growing fatigue cracks, *Journal of the Royal Society Interface*, 4 (13), 395-403, 2007.

9. Jones, A.S., Rule, J.D., Moore, J.S., White, S.R., Sottos, N.R., Catalyst morphology and dissolution kinetics for self-healing polymers, *Chemistry of Materials*, 18, 1312-1317, 2006.

10. Jones, A.S., Shaw, J.A., Wineman, A.S., An Experimental Facility to Measure the Chemorheological Response of Inflated Elastomeric Membranes at High Temperature, *Experimental Mechanics*, 46 (5), 579-587, 2006.

Synergistic Activities

1. Founding member of the Richard G. Lugar Center for Renewable Energy.
2. Board member of the Indiana Renewable Energy Collaboration
3. ABET coordinator for the Mechanical Engineering Department responsible for all assessment and evaluation.
4. Pi Tau Sigma honorary engineering fraternity faculty adviser
5. Engineering and Technology Multi-Disciplinary Undergraduate Research Institute Advisory Board member.

BIOLOGICAL SKETCH

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Professional Preparation:

Universidad Politécnica de Madrid, Aeronautical Engineering, Bachelor of Science, 2005
Universidad Politécnica de Madrid, Aeronautical Engineering: Aeronaves y Vehículos Espaciales (Aeroplanes and Spaceships), **Master of Science, 2005**
Yale University, Mechanical Engineering, **Master of Science and Master of Philosophy, 2009**
Yale University, Mechanical Engineering, Ph.D., 2010

Appointments:

(8)2015-Present	Faculty, Tenure Track Assistant Professor, Mechanical Engineering, **IUPUI**
(10)2013-2015(7)	Postdoctoral Associate, Mechanical Engineering, **University of Minnesota**
(5)2013-(10)2013	Postdoctoral Associate, Chemistry**, Indiana University.**
(4)2011-2013(4)	Postdoctoral Associate, Mechanical Engineering, **University of Minnesota**.
2010-2011(4)	Postdoctoral Associate, Mechanical Engineering, **Yale University**.
2007-2010	Graduate Student, Mechanical Engineering, **Yale University Ph.D.**
2006-2007	Visiting Assistant in Research (Jan 2006), Mechanical Engineering, **Yale University**.
2005-2006	Employee, **Iberia** Airlines-Aircraft Line Maintenance: Engines General Electric CF-86, Trent 500; Airbus A320, A340

Publications:

2017 -Nahin M., Oberreit D.,Fukushima N., **Larriba C.** "Modeling of an Inverted Drift Tube for Improved Mobility Analysis of Aerosol Particles" Nature Sci Rep-UK, DOI: 10.1038/s41598-017-06448-w.

2015 **-Larriba C.,** Hogan C. Clemmer,D.E. "Gas molecule scattering & ion mobility measurements for organic macro-ions in He *versus* N_2 environments" Phys Chem Chem Phys,17 15019-15029.

2013 **-Larriba C.,** Hogan C. "Free Molecular Collision Cross Section Calculation Methods for Nanoparticles and Complex Ions with Energy Accommodation" J Comp Phys, 251, 344.

2013 **-Larriba C.,** Hogan C. "Momentum Transfer Collision Cross Sections and Ion Mobilities in Diatomic Gases: Measurement vs. Prediction with Non-Specular Scattering Models" J. Phys Chem A 117, 3887.

2012 -Chonglin Zhang, Thaseem Thajudeen, **Larriba C.**, Schwartzentruber T., Hogan C. "The Scalar Friction Factor for Non-spherical Particles and Aggregates Across the Entire Knudsen Number Range from Dimensional Analysis and Direct Simulation Monte Carlo (DSMC)". Aerosol Sci Tech 46(10): 1065-1078.

Other relevant Publications:

2017 -Shrivastav, V., Nahin, M., Hogan, C., **Larriba, C.** "Benchmark Comparison for a Multi-Processing Ion Mobility Calculator in the Free Molecular Regime" J. Am. Soc. Mass Spectrom. 28, 1540.

2013 **-**Ouyang H., **Larriba C.**, Oberreit D., Hogan C. "The Collision Cross Sections of Iodide Salt Cluster Ions in Air via Differential Mobility Analysis-Mass Spectrometry" J. Am. Soc. Mass Spectrom., 24, 12, 1833-47.

2013 **-Larriba C.,** Fernández de la Mora J., Clemmer, D.E. "Electrospray Ionization Mechanisms for Large Polyethylene Glycol Chains studied through Tandem Ion Mobility Spectrometry" J. Am. Soc. Mass Spectrom., 25, 1332-1345.

2011 **-Larriba, C.**, Hogan, C. et al. "The Mobility-Volume Relationship below 3.0 nm examined by Tandem Mobility-Mass Measurement" Aerosol Sci and Tech, 45(4): 453-467.

2011 **-Larriba, C.**, Fernandez de la Mora, J. "The Gas Phase Structure of Coulombically Stretched Polyethylene Glycol Ions" J Phys Chem B, 116, 593-598.

Synergistic Activities

- ***Chair of the Aerosol Physics Session American Association of Aerosol Research (AAAR).*** 3 consecutive years. ***Chair of the Ion Mobility: Structure session at the American Society of Mass Spectrometry (ASMS)***.

- Part of the ***Integrated Nanosystems Development institute*** (INDI) at IUPUI which is fully commited to the research development of K-12 students and teachers through its RETAIN and NEST summer programs.

- ***Creator of IMoS (Ion MObility Spectrometry Software)***, a theoretical and numerical tool which can predict the mobilities of ions in the gas phase considering non-specular scattering models based on the ***Kinetic Theory of Gases***, ***and is, in my opinion, the most advanced code available today for such calculations***. It can be downloaded from www.impospedia.com

- ***MURI (Multidisciplinary Undergraduate Research Institute) Summer Project Advisor: http://www.imospedia.com/research/in-space-electrical-propulsion***

- Member of the ***Editorial Advisory Panel*** for ***Nature Scientific Reports Journal***.

Biographical Sketch

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(a) Education & Training

Indian Institute of Technology, Kanpur, India	Mechanical Engineering	B.Tech., 1983
Cornell University, Ithaca, NY	Mechanical Engineering	M.S., 1985
Cornell University, Ithaca, NY	Aerospace Engineering	Ph.D., 1994
NASA Lewis Research Center, Cleveland, OH	Combustion & Turbomachinery	post-doc, 1994-1997

(b) Research and Professional Experience

- 2008-present, Professor of Mechanical Engineering & Adjunct Professor of Biomedical Engineering, IUPUI, IN
- 2010-present, Associate Dean for Research & Graduate Programs, Purdue School of Engineering and Technology, IUPUI, Indianapolis, IN.
- 2008-2010, Associate Chair of Mechanical Engineering, IUPUI, IN.
- 2004-2008, Graduate Chair of Mechanical Engineering & Adjunct Associate Professor of Biomedical Engineering, IUPUI, IN.
- 2003-2008, Associate Professor of Mechanical Engineering, IUPUI, IN.
- 1997-2003, Assistant Professor of Mechanical Engineering, IUPUI, IN.
- 1994-1997, Research Associate, NASA Lewis Research Center, Cleveland, OH.
- 1994, Project Engineer, CFD Research Corporation, Huntsville, AL.
- 1989-1994, Research Associate / Research Assistant, Aerospace Engineering, Cornell University, Ithaca, NY.
- 1989, Manager - Research Programs, Diesel and Gas Engineering Co., Beaver Dams, NY.
- 1985-1989, Research Staff Engineer, Diesel and Gas Engineering Co., Beaver Dams, NY.
- 1984, Research Assistant, Mechanical Engineering, and Teaching Assistant, Physics, Cornell Univ., Ithaca, NY.

(c-i) Related Publications

1. R. R. Jagannath, S. P. M. Bane, M. E. Feyz, & M. R. Nalim, “Assessment of Incidence Loss and Shaft Work Production For Wave Rotor Combustor with Non-Axial Channels,” AIAA-2017-1749, Jan 2017.
2. M. R. Nalim, P.H. Snyder, M. Kowalkowski, “Experimental Test, Model Validation, and Viability Assessment of a Wave-Rotor Constant-Volume Combustor,” *AIAA Journal of Propulsion & Power*, 2017.
3. A. Karimi, M. R. Nalim, “Ignition by Hot Transient Jets in Confined Mixtures of Gaseous Fuels and Air,” *Journal of Combustion*, Volume 2016, Article ID 9565839, 13 pages, 2016.
4. R. Jagannath, M. Rajagopal, S. Bane, R. Nalim, "Real-Gas Thermodynamic Analysis of the Wave-Rotor Combustion Turbine", 10th HEFAT2014, Orlando, FL, 2014.
5. Md Nazmuzzaman Khan, Kyong-yup Paik, and M Razi Nalim, “3D Computation for Torch Jet Ignition Of Premixed Methane-Hydrogen-Air Blends in a Pre-Chamber Constant Volume Combustor At Variable Pre-Chamber Pressure,” AAIA-2015-3784, 51st JPC, Propulsion & Energy Forum, Jul 2015, Orlando, FL.
6. Ravichandra R. Jagannath, Sally P. M. Bane, M. R. Nalim, “Wave Rotor Combustor Turbine Model Development,” AIAA 2015-4188, 51st JPC, Propulsion & Energy Forum, Jul 2015, Orlando, FL.
7. A. Karimi, M. Rajagopal, R. Nalim, “Traversing Hot-Jet Ignition in a Constant-Volume Combustor,” ASME Journal of Engineering for Gas Turbines and Power, vol. 136, No. 4, 2014.
8. V. Kilchyk, R. Nalim, & C. Merkle, “Scaling Interface Length Increase Rates in Richtmyer-Meshkov Instabilities,” ASME Journal of Fluids Engineering, vol. 135, no. 3, 2013.
9. V. Kilchyk, R. Nalim & C. Merkle, "Laminar Premixed Flame Fuel Consumption Rate Modulation by Shocks and Expansion Waves," Combustion & Flame, vol. 158, no. 6, pp. 1140-1148, June 2011.
10. T. Elharis, S. Wijeyakulasuriya, M.R. Nalim, "A Two-Step Reaction Model for Stratified-Charge Combustion in Wave-Rotors," AIAA-2011-5748, 47th JPC, San Diego, CA, July 2011.
11. I. Perera, S. Wijeyakulasuriya, R. Nalim, "Hot Combustion Torch Jet Ignition Delay Time for Ethylene-Air Mixtures ," AIAA-2011-95, 49th ASM, Orlando, FL, Jan 2011.

12. M. Razi Nalim , Tarek M. Elharis , Sameera D. Wijeyakulasuriya , and Zuhair A. Izzy, "Wave Rotor Combustor Aerothermodynamic Design and Model Validation based on Initial Testing," AIAA 2010-7041, 46th JPC, Nashville, TN, Jul 2010.
13. Yu Matsutomi, Scott E. Meyer, Sameera Wijeyakulasuriya , Zuhair Izzy, M. Razi Nalim, Masayoshi Shimo, Mike Kowalkowski, and Phil H. Snyder, "Experimental Investigation on the Wave Rotor Combustor," AIAA 2010-7043, 46th JPC, Nashville, TN, Jul 2010.
14. H. Li, M.R. Nalim & C. Merkle, "Transient Thermal Response of Turbulent Compressible Boundary Layers," ASME Journal of Heat Transfer, Vol. 133, 2011.
15. V. Kilchyk, R. Nalim and C. Merkle, "Baroclinic Vortex Sheet Production by Shocks and Expansion Waves," Shock Waves, vol. 20, no. 5, pp. 367-380, 2010.
16. P. Akbari & M. R. Nalim, "Review of Recent Developments in Wave Rotor Combustion Technology," AIAA Journal of Propulsion & Power, vol. 25, no. 4, pp.833-844, Jul-Aug 2009.
17. P. Akbari, M. R. Nalim, E. S. Donovan, & P. H. Snyder, "Leakage Assessment of Pressure-Exchange Wave Rotors," AIAA Journal of Propulsion & Power, vol. 24, no. 4, Jul-Aug 2008.
18. P. Akbari, M.R. Nalim, and N. Müller, "A Review of Wave Rotor Technology and Recent Developments," ASME Journal of Engineering for Gas Turbines and Power, v.128, no.4, pp.717-735, Oct 2006.

(c-ii) Other Significant Publications

19. S. Krishnan & R. Nalim, "Project-based Learning in Introductory Thermodynamics," Paper AC 2009-1911, Proceedings of the 116th ASEE Annual Conference, Austin, TX, Jun 2009.
20. M. Razi Nalim & Sivakumar S. Krishnan, "Project-Based Learning in Introductory Thermodynamics," ASEE Global Colloquium, GC 2009-247, Budapest, Hungary, Oct 2009.

(d) Synergistic Activities

- Associate Director (IUPUI), Indiana Space Grant Consortium, 2001-2004. Local point of contact for NASA's public outreach. Initiated scholarships to undergraduate students to extend research interests to K-12 students. Served on statewide committee to develop Indiana's aerospace workforce.
- Faculty Advisor, IUPUI section of the American Institute of Aeronautics & Astronautics (AIAA), 1998-2003. Coached members to award-winning papers at regional conferences, advised NASA Moonbuggy race team.

(e) Collaborators & Other Affiliations

• Collaborators and Co-Editors (other than advisors and advisees mentioned next).

- University of Illinois Chicago: Suresh Aggarwal.
- Tuskegee University: M. Javed Khan
- Virginia Commonwealth University: Ramana Pidaparti, Manu Mital
- Indiana University: Hiroki Yokota, Lingxi Li, Peter Orono, Zuhair Izzy, Arif Khalid, Jing Zhang, Andres Tovar
- Michigan State University: Norbert Müller, E. Dempsey, E. Szpynda.
- Purdue University: Steve Heister, Charles Merkle, Jay Gore, Scott Meyer, Sally Bane.
- Rolls-Royce: Philip Snyder, Lynn Snyder (retired), M.S. Anand
- Indian Institute of Technology, Kanpur: Avinash Agarwal.

• Graduate and Postdoctoral Advisors.

- Emeritus Prof. Edwin Resler, Jr.; Cornell University
- Dr. Larry Bober, deceased; NASA

• Thesis Advisor and Postgraduate-Scholar Sponsor.

Graduate Thesis Students, total 22:

- Current at IUPUI: Mohammad Feyz, Ali Tarraf, Arshad Chowdhury, Glenn Patterson
- Graduated: Arash Jamali, Abdullah Karimi , Kyong-Yup Paik, M.N. Khan, Prasanna Chinnathambi (Mahle Powertrain), Sameera Wijeykulasuriya (Convergent Science), Brian Froelich (Cummins), Keith Smith (Bank of America), Indika Perera (RPI), Tarek Elharis (Cummins), Zachary Lightner (Bettis Atomic Power), Hongwei Li (Technical University of Denmark), Viktor Kilchyk (Praxair), Dhruv Baronia (CD-Adapco), John Bowman (Cummins), Arnab Banerjee (Holset Turbochargers),Tao Geng, Snehaunshu Chowdhury, Berrak Alparslan, (TEI, Turkey), Kok Kee Fong (Uniten, Malaysia), Felicia Hinant (GE Aviation)

Postgraduate-scholars, total 4:

- Mani Rajagopal, Ford; Kerem Pekkan; Carnegie-Mellon U.; Pezhman Akbari; Columbia U., Arif Khalid, GE.

NSF Biographical Sketch

Nilsson Holguin
Assistant Professor
NHolguin@iupui.edu
SL 164Q: 317-278-0624
MS 5055P: 317-278-2642

Professional Preparation

Trinity College	Hartford, CT	Engineering	BS/2005
Stony Brook University	Stony Brook, NY	Biomedical Engineering	PhD/2010
Washington University	St. Louis, MO	Orthopaedic Surgery	2017

Appointments

IUPUI
Assistant Professor, Department of Mechanical Engineering
Indiana Center for Musculoskeletal Health (ICMH) Investigator

Publications

Sun D., Brodt M, Zannit H., Holguin N, Silva M. (2017) Evaluation of loading parameters for murine axial tibial loading: Stimulating cortical bone formation while reducing loading duration. *J Orthop Res*. doi: 10.1002/jor.23727

Rai MF, Duan X, Quirk JD, Holguin N, Schmidt EJ, Chinzei N, Silva MJ, Sandell LJ (2017). Early changes in the knee of healer and non-healer mice following non-invasive mechanical injury. *Sci Rep.* Mar 27;7:45223.

Xin, D., Holguin, N., Rai, M.F., Patra, D., Liao, W., Silva, M., Sandell, L. (2016). Early changes in the knee of healer and non-healer mice following non-invasive mechanical injury. J Orthop Res. Sep 3. doi: 10.1002/jor.23413. [Epub ahead of print]

Yan, H., Xin, D., Pan, H, Holguin, N., Rai, M.F., Akk, A., Springer, L., Wickline, S., Sandell, L., Pham, C. (2016) Suppressing NF-kB activity in early cartilage responses to injury: a nanotherapeutic approach. Proc Natl Acad Sci USA Oct 11; 113(41), E6199-E6208

Holguin, N., Brodt, M.D., Silva, M.J. (2016). Aging impairs activation of Wnt signaling by mechanical loading in the bone of old mice. J Bone and Miner Res. DOI: 10.1002/jbmr.2900.

Holguin, N. (2016). CORR Insights: The NLRP3/Caspase-1/Interleukin-1β Axis Is Active in Human Lumbar Cartilaginous Endplate Degeneration. Clin Orthop Relat Res. 474(8), 1827-1829

Holguin, N. (2016). CORR Insights: Does sclerostin stimulate fracture healing in a mouse model? Clin Orthop Relat Res. May;474(5):1303-6.

Chen J, Holguin, N., Yu, S., Silva M.J., Long F. (2015). mTORC2 signaling promotes skeletal growth and bone formation in mice J Bone and Miner Res Feb; 30(2):369-78.

Holguin, N., Brodt, M.D., Sanchez, M.E., Silva, M.J. (2014). Aging diminishes lamellar and woven bone formation induced by tibial compression in adult C57Bl/6 Bone August; 65: 83-91.

Holguin, N., Aguilar, N., Harland, R., Silva M.J. (2014). The aging mouse partially models the aging human spine: lumbar and coccygeal disc height, composition, mechanical properties and Wnt signaling in young and old mice. J Appl Physiol June; 116(12): 1551-60.

Wu, P., Holguin, N., Silva, M.J., Liao, W., Sandell, L.J. (2014). Early response of mouse joint tissues to noninvasive knee injury suggests treatment targets. Arthritis and Rheumatism May; 66(5): 1256-65.

Holguin, N., Brodt, M.D., Sanchez, M.E., Lynch, M.A., Kotiya, A.A., Silva, M.J. (2013). Adaptation of tibial strength and structure to axial compression is more dependent on loading history than mouse strain. Calcif Tis Int Sep; 93(3): 211-21.

Holguin, N., Martin, J., Elliott, D.M., Judex, S. (2013). Brief, low-intensity vibration partially maintains intervertebral disc mechanics and spinal muscle area during deconditioning. Spine Journal Apr; 13(4):428-36.

Holguin, N., Uzer, G, Chiang, F., Rubin, C., Judex, S. (2011). Brief daily exposure to low-intensity vibration mitigates the degradation of the intervertebral disc in a frequency-specific manner. J Appl Physiol Dec; 111(6):1846-53.

Holguin, N., Judex, S. (2010). Rat intervertebral disc health during hindlimb unloading: brief ambulation with or without whole-body vibration. Aviat Space Environ Med Dec; 81(12)1078-84.

Holguin, N., Muir, J., Rubin, C., Judex, S. (2009). Short applications of very low-magnitude vibrations attenuate expansion of intervertebral disc during extended bed rest. Spine Journal Jun; 9(6):470-7.

Synergistic Activities

Member of Biomedical Engineering Society	2015-2016
Member of American Society of Bone and Mineral Research	2014-Present
Member of Orthopaedic Research Society	2011-Present

Biographical Sketch
Ali Razban

a. Professional Preparation

Univ. of Michigan, Ann Arbor, MI	Electrical Eng.	M.S., 1988
Imperial College, London, UK	Mechanical Eng.	Ph.D., 1994
Purdue University, West Lafayette, IN	Executive Management	MBA, 2005

b. Appointments

2016– Present, Clinical associate Professor, Indiana University Purdue University (IUPUI), Indianapolis, IN
2010-2016, Senior Lecturer, Indiana University Purdue University (IUPUI), Indianapolis, IN
2008 –2009, Senior Project Engineer, Allison Transmission, Inc., Indianapolis, IN
2006 –2008, R&D Supplier Quality Eng., Roche Diagnostics Operations, Indianapolis, IN
2002–2006, Process Development Eng., Roche Diagnostics Operations, Indianapolis, IN
1998 –2001, Senior Research & Development Engineer, Universal Instruments Corp., Binghamton, NY
1995–1998, Senior Automation Engineer, Harman Motive, OEM, Group, Martinsville, IN
1989 –1994, Project Manager and Research Associate, Imperial college, London, UK

c. Recent publications

(i) Journals

1. Wu, D. Amini, A., **Razban, A**. and Chen, J.,ARC algorithm: a novel approach to forecast and manage daily electrical maximum demand, J. of Energy 2017, under review
2. **Razban, A.**, *Zambare, H. and Patil, S. and., PID Controller Design for Magnetorheological Active Suspension including Hysteresis Modeling, IEEE Transactions on Control Systems Technology, 2017, under review.
3. Zambare, H, Khojie, A, Patil, S. and **Razban, A**., MR damper modeling performance comparison including hysteresis and Damper optimization, submitted to ASME Journal of Dynamic Systems, Measurement and Control, 2017, under review.
4. **Razban, A**., Khatib, A., Goodman, D., Chen, J, Mechanical modeling of air handling unit subsystem in a commercial building, Journal of Thermal Science and Engineering Progress, 2017, under review.
5. Bearden, L., **Razban, A**., An Automated Grid-Based Robotic Alignment System for Pick and Place Applications, Journal of Intelligent and Robotics Systems, 84 (1), 815-828, 2016, DOI 10.1007/s10846-016-0363-y.
6. Malguarnera, M., **Razban, A**., Utility ownership of combined heat and power: an economic model based approach, International Journal of Research in Engineering and Technology, Vol 4, issue 11, pp 131-139, Nov. 2015.

(ii) Conferences

1. Wu, D. Amini, A., **Razban, A**. and Chen, J. , A Novel Approach to Forecast and Manage Daily Electrical Maximum Demand, Proceedings of ECOS 2017, The 30th International Conference on Efficiency, Cost, Optimization, Simulation and environmental impact of Energy Systems, July 2-6, 2017, San Diego, CA.
2. Zambare, H, Vyas, V., Nagesh, S. and **Razban, A**., Performance Simulation of Optimized Stock 2014 Ducati Panigale 899 for Quarter Mile Drag Racing, 2nd Biennial International Conference on Nascent Technologies in Engineering (ICNTE 2017), IEEE Xplore, PP. 1-6, DOI: 10.1109/ICNTE.2017.7947897.
3. **Razban, A**., Edalatnoor, A., Goodman, D., and Chen, J, Energy optimization of air handling unit using CO2 data and coil performance, Proc. of the ASME 2016 International Mechanical Engineering Congress and Exposition (IMECE2016), Nov. 2016, ISBN: 978-0-7918-5059-6, doi:10.1115/IMECE2016-66271.

4. Goodman, D., Chen, J., **Razban, A**., and Li, J., Identification of key parameters affecting energy consumption of air handling unit, Proc. of the ASME 2016 International Mechanical Engineering Congress and Exposition (IMECE2016), Nov. 2016, ISBN: 978-0-7918-5059-6, doi:10.1115/IMECE2016-66258.
5. **Razban, A.**, Khatib, A., Chu, Y., Comparison of energy consumption between Lid resistive heating and immersion rod heating furnaces in aluminum die casting industry, Proc. of NADCA Die Casting Congress, Sept. 2014.
6. Cambridge, J., Frazier, S., Goodman, D., Nofal, M. and Razban, A., Compressed Air Efficiency: A Case Study Combining Variable Speed Control with Electronic Inlet Valve Modulation, Proc. of Society of Automotive Engineers (SAE) International, 13SDP-035, Detroit, MI, April 2013, ISSN 0148-7191, doi:10.4271/2013-01-0834.

d. Synergistic Activities

(1) Received a $105,691 research grant as Co-PI with collaboration with Qatar university for "Innovative MBSE Model of System of Systems for Management and Control Optimization of a Multi-plant District Cooling Grid", 2017-2020

(2) Chen, J (PI, 40% effort), **Razban, A**. (Co-PI, 25% effort), Goodman, D. (Co-PI, 25% effort), Justice, C. (Co-PI, 5% effort), Chien, S (Co-PI, 5% effort), DE-FOA-0000490, Industrial Assessment Center – integration of education and practice, $1,574,000. 2016-2021.

(3) **Razban, A.** (PI, 100% effort), CLEAResult Corp., "Energy audit, energy consumption evaluation and recommendation implementation of industrial sectors", $75,000, 2015-2017

(4) **Razban, A.** (PI, 100% effort), EPA (U.S. Environmental Protection Agency), "Modeling of Air handling unit for wireless monitoring", $14,500, 2014-2015

(5) **Razban, A.** (PI, 100% effort), Ryobi Die Casting USA Inc., "Comparison of energy consumption between Lid resistive heating and immersion rod heating furnaces in aluminum die casting industry", $2000, 2014

(6) Chen, J (PI, 40% effort), **Razban, A**. (Co-PI, 25% effort), Goodman, D. (Co-PI, 25% effort), Anwar, S (Co-PI, 5% effort), Xie, J (Co-PI, 5% effort), DE-FOA-0000490, Establishing an Industrial Assessment Center, $1,320,000. 2011-2016.

(7) Served as an external MS. thesis examiner for Mai Hamed Fetais, Oater University, 2017

(8) Developed a graduate Certificate in Energy Management", 2012

(9) Developed two courses for Energy Engineering undergraduate curriculum

e. Collaborators & Other Affiliations

Graduate Advisors (Total = 8 currently)

PhD Advisor(s): Mahesh Shewale and John Warren (both current students)

*Thesis Advisor and Postgraduate-Scholar Sponsor (past 5 years, *women)*

1. Hrishikesh Zambare, (MS2017)- John Deer, Waterloo, IA.
2. Tangirala Deepak Kumar (MS 2017)- Medtronic, Warsaw, IN
3. Amin Amini (MS2017)- AECOM, Orange, CA.
4. Arash Edalatnoor (MS2016)- Solar Turbine, San Diego, CA.
5. Lukas R Bearden (MS 2013)-APTUS Design Works, Inc., Alcoa, TN;

Jong Eun Ryu, Ph.D.
Assistant Professor, Department of Mechanical Engineering
Purdue School of Engineering and Technology
Indiana University-Purdue University Indianapolis (IUPUI)
Indianapolis, Indiana

Professional Preparation:

KAIST, Korea	Mechanical Engineering	B.S.	2004
KAIST, Korea	Mechanical Engineering	M.S.	2006
University of California, LA	Mechanical, Micro/Nanotechnology	Ph.D.	2009
University of California, LA	Nanotechnology and Manufacturing	Postdoc	2009-2011

Appointments:

2013 – present Assistant professor, Mechanical Engineering, IUPUI, IN
2011 – 2013 Senior Engineer, Logic Technology Development, Intel Corporation, OR

Products:

Relevant Publications:

1. S. Wang, S. Ota, B. Guo, J. Ryu, C. Rhode, Y. Xiong, S. Kalim, L. Zeng, Y. Chen, M. Teitell, X. Zhang, "Subcellular Resolution Mapping of Endogenous Cytokine Secretion by Nano-Plasmonic-Resonator Sensor Array," Nano Letters, 11, 3431-3434 (2011)
2. S. Ota, S. Wang, J. Ryu, Y. Wang, Y. Chen, X. Zhang, "Intracellular delivery of top-down fabricated tunable nano-plasmonic resonators," Nanoscale, 5, 10179-10182, (2013)
3. Z. Guo, J. Zhu, S. Wei, L. Zhang, Y. Mao, J. Ryu, N. Haldolaarachchige, A. Karki, D. Young, "Polyaniline-tungsten oxide metacomposites with tunable electronic properties," Journal of Materials Chemistry, 21, 342-348 (2011)
4. X. Zhang, J. Zhu, N. Haldolaarachchige, J. Ryu, D. Young, S. Wei, Z. Guo, "Synthetic Process Engineered Polyaniline Nanostructures with Tunable Morphology and Physical Properties," Polymer, Vol 53, 2109 – 2120, (2012)
5. J. Zhu, S. Wei, L. Zhang, Y. Mao, J. Ryu, N. Haldolaarachchige, D. Young, Z. Guo, "Electrical and dielectric properties of polyaniline–Al2O3 nanocomposites derived from various Al2O3 nanostructures," Journal of Materials Chemistry, 21, 3952-3959 (2011)

Other Significant Publications:

1. J. Zhu, S. Wei, J. Ryu, L. Sun, Z. Luo, Z. Guo, "Magnetic epoxy resin nanocomposites reinforced with core-shell structured Fe@FeO nanoparticles: fabrication and property analysis," ACS Applied Materials & Interfaces, 2, 2100-2107 (2010)
2. Y. Li, J. Zhu, S. Wei, J. Ryu, L. Sun, Z. Guo, "Poly(propylene)/Graphene Nanoplatelets Nanocomposites: Melt Rheological Behaviors and Thermal, Electrical and Electronic Properties," Macromolecular Chemistry and Physics, 212, 1951-1959 (2011)
3. J.S. Kang, J. Ryu, H.S. Kim, H.T. Hahn, S. Jang, J.W. Joung, "Sintering of inkjet printed silver nanoparticles at a room temperature by using the intense pulsed light," Journal of Electronic Materials, 40, 2268-2277 (2011)
4. C. Cheng, R. Fan, Z. Wang, Q. Shao, X. Guo, P. Xie, Y. Yin, Y. Zhang, L. An, Y. Lei, J. Ryu, A. Shankar, Z. Guo, "Tunable and weakly negative permittivity in carbon/silicon nitride composites with different carbonizing temperatures," Carbon, 125, 103-112 (2017)
5. J. Zhu, L. Zhang, Y. Mao, P. Mavinakuli, D. Young, Z. Guo, S. Wei, J. Ryu, A. Karki, "Conductive polypyrrole/tungsten oxide metacomposites with negative permittivity," Journal of Physical Chemistry C, 114, 16335-16342 (2010)

Synergistic Activity:

1. Summer Faculty Fellowships at Air Force Research Lab (OH) for the research on the chalcogenide polymer and infrared plasmonic sensors (2015, 2016)
2. The school is the member of NNMIs: Flexible Hybrid Electronics Manufacturing Innovation Institute (NextFlex) and National Additive Manufacturing Innovation Institute (AM).
3. Participation in undergraduate research mentoring programs: Undergraduate Research Opportunity Program, Multidisciplinary Undergraduate Research Institute, Commitment to Engineering Excellence Research
4. New course development of ME497 Nanomaterials and Measurements and ME597 Flexible Electronics; Course renovation for ME423 Introduction to Nanotechnogy; Course coordinators of ME497 Nanomaterials and Measurements, ME597 Flexible Electronics, ME423 Introduction to Nanotechnogy, and ME597 Integrated Nanosystems Processes and Devices
5. Service activities including NSF panels of NM (14, 16), NanoBiosensing (16), MEP (16); journal editor of Advanced Composites Science; journal reviewers of Journal of Composite Materials, RSC Advances reviewer, Journal of Nanoscience and Nanotechnology, Optics Letters, ECS Journal of Solid State Science and Technology, Biosensors and Bioelectronics.

ANDRES TOVAR

a. Professional Preparation

National University of Colombia	Mechanical Engineering	BS 1995
National University of Colombia	Industrial Automation	MS 2000
University of Notre Dame	Mechanical Engineering	MS 2004
University of Notre Dame	Aerospace and Mechanical Engineering	PhD 2005

b. Appointments

Indiana Univ-Purdue Univ Indianapolis	Associate Professor	2017 – present
Indiana Univ-Purdue Univ Indianapolis	Assistant Professor	2011 – 2017
University of Notre Dame	Research Assistant Professor	2008 – 2011
National University of Colombia	Associate Professor	2005 – 2008
National University of Colombia	Assistant Professor	2000 – 2005

c. Products

PRODUCTS MOST CLOSELY RELATED

1. Liu, K., D. Detwiler, A. Tovar. *Optimal Design of Nonlinear Multimaterial Structures for Crashworthiness using Cluster Analysis*. ASME Journal of Mechanical Design, Vol. 139, Issue 10, Pages 101401 (11 pages), doi: 10.1115/1.4037620, 2017
2. Wu, T., K. Liu, A. Tovar. *Multiphase Topology Optimization of Lattice Injection Molds*. Computers & Structures, Vol. 192, Pages 71-82, https://doi.org/10.1016/j.compstruc.2017.07.007, 2017
3. Liu, K., Z. Xu, D. Detwiler, A. Tovar. *Optimal Design of Cellular Material Systems for Crashworthiness.* SAE Technical Paper 2016-01-1396, https://doi.org/10.4271/2016-01-1396, 2016
4. Bandi, P., D. Detwiler, J. Schmiedeler, and A. Tovar. *Design of Progressively Folding Thin-Walled Tubular Components Using Compliant Mechanism Synthesis*. Thin-Walled Structures, Vol. 37, Issue 2, Pages: 723-735, doi:10.1007/s40430-014-0197-0, 2015
5. Liu, K. and A. Tovar. *An efficient 3D topology optimization code written in Matlab*. Structural and Multidisciplinary Optimization, Vol. 50, Issue 6, Pages: 117-1196, doi:10.1007/s00158-014-1107-x, 2014

OTHER SIGNIFICANT PRODUCTS

1. Sego, T.J., U. Kasacheuski, D. Hauersperger, A. Tovar, N.I. Moldovan. *A Heuristic Computational Model of Basic Cellular Processes and Oxygenation during Spheroid-Dependent Biofabrication*. Biofabrication, Vol. 9, Issue 2, Pages 024104, 2017
2. Lischke, F. and A. Tovar. *Design of Self-supporting 3D Structures for Fused Deposition Modeling*. In Paper No. DETC2016-60569, pp. V004T05A009; 9 pages, from: ASME Additive Manufacturing + 3D Printing Conference (AM3D), doi:10.1115/DETC2016-60569, 2016
3. Wu, T., S.A. Jahan, P. Kumaar, A. Tovar, H. El-Mounayri, Y. Zhang, J. Zhang, D. Acheson, K. Brand, R. Nalim. *A framework for optimizing the design of injection molds with conformal cooling for additive manufacturing*. Procedia Manufacturing, Vol. 1, Pages: 404-415, doi:10.1016/j.promfg.2015.09.049, 2015
4. León, D., N. Arzola, and **A. Tovar**. *Statistical analysis of the influence of tooth geometry in the performance of harmonic drive*. Journal of the Brazilian Society of Mechanical Sciences and Engineering. Vol. 37, Pages: 723-735, 2015, doi:10.1007/s40430-014-0197-0, 2015
5. Lee, S. and **A. Tovar**. *Outrigger placement in tall buildings using topology optimization*. Engineering Structures. Vol. 74, Issue 1, Pages: 122-129, doi:10.1016/j.engstruct.2014.05.019, 2014

d. Synergistic Activities

1. Proposed the HCA method for topology optimization (commercially available since 2009), Compliant tubes for progressive folding (invention disclosure: IU 13069, 2012), and Ultra-lightweight blast mitigating structure (U.S. Provisional Patent 61/830, 2013). Winner of the DOE/ARPA-E-Local Motors LITECAR Challenge 2015
2. Developed five graduate courses at IUPUI: Topology Optimization (2012), Optimum Design of Complex Mechanical Systems (2014), Additive Manufacturing (2015), Design of Complex and Origami Structures (2016), and Design of Mechatronic Systems (2017). Received IUPUI Department of Athletics Favorite Professor Award (2013, 2014, 2015), SAE Ralph R. Teetor Educational Award (2014), Wisner-Stoelk Outstanding Faculty Award (2015), and Indiana University Trustees Teaching Award (2016)
3. Symposium co-organizer and review coordinator for ASME IDETC (2017, 2016, 2015, 2014, 2013, 2012); International Participants Chair for IDETC (2012). Scientific Committee Member for ISSMO EngOpt (2016, 2014, 2010, 2008)
4. Faculty Advisor for Society of Hispanic and Professional Engineers SHPE IUPUI Chapter (since 2011) and the IUPUI Robotics Club (since 2012). Awarded as Best Faculty Advisor by the Purdue Engineering and Technology Student Council (2014)
5. Coordinator of the NSF Research Group at IUPUI (since 2013), and Graduate Education and Research Committee Member for the Mechanical Engineering Department (2013-15). Editorial membership: Journal of Surfaces and Interfaces of Materials (Editorial Board), Journal Intekhnia (Scientific Committee), Austin Journal of Robotics (Editorial Board)

e. Collaborators & Other Affiliations

1. **Collaborators**—total number of collaborators and co-editors (11)
   Nelson Arzola (National U of Colombia); Duane Detwiler (Honda R&D Americas); Lianshui Guo (Beijing U of Aeronautics & Astronautics); Kapil Khandelwal (U Notre Dame); Soobum Lee (U of Maryland); Chandan Mozumder (General Motors); Jim Schmiedeler (U Notre Dame); Vikas Tomar (Purdue U); Bernardo Uribe (National U of Colombia); Layne T. Watson (Virginia Tech); Hiroki Yokota (IUPUI)
2. **Graduate Advisor(s)**—total number of graduate advisors (2)
   John Renaud (U Notre Dame, MS and PhD); Hernando Díaz, (National U of Colombia, MS)
3. **Postdoctoral Sponsor(s)**—total number of postdoctoral sponsors (1)
   John Renaud (U Notre Dame) (Tovar was affiliated as Assistant Research Professor)
4. **Thesis Advising and Postgraduate-Scholar Sponsor** (since 2011)
   MS students: Joel Najmon (current); Namrata Upadhyaya (current); Prasad Tapkir (current); Jennifer Solid (current); Prathamesh Chaudhari (current); Homero Valladares (2017, PhD IUPUI); T.J. Sego (2016, PhD IUPUI); Vaibhav Gokhale (2016, India); Fabian Lischke (2016, Bosch); Parisa Ghane (2015, PhD Texas A&M); Kunal Khadke (2015, GM); Satyajeet Shinde (2014, Ford);
   Anahita Emami (2014, PhD Virginia Tech), Kai Liu (2013, PhD Purdue U); Joshua Israel (2013, W Virginia U); Jaime Arcos (2013, PhD National U Colombia); Maria F Espitia (2012, National U Colombia); Andres J Arias (2011, Autonomous U of Manizales)
   PhD Students: Homero Valladares (current); T.J. Sego (current); Sajjad Raeisi (current); Tong Wu (current); Kai Liu (current); Jaime Arcos (current); Luis C Sarmiento (2016, Pedagogic U Colombia); Punit Bandi (2012, GM)
   Post-doctoral Scholars: Yaghob Gholipour (current); Di Chi (2015-2016, BUAA, China); Weigang An (2012-2013, Northwestern Polytechnic U, China)
   Total number of graduate students advised (26) (18 MS and 8 PhD)
   Total number of post-doctoral scholars advised (3)

DIANE R. WAGNER

a. Professional Preparation

University of Michigan	Mechanical Engineering	B.S. 1989
University of California, Berkeley	Mechanical Engineering	Ph.D. 2002
Stanford University	Cell Biology/Tissue Engineering postdoc	2003-2005

b. Appointments

2015 – current	Associate Professor, Dept. of Mechanical Engineering, IUPUI
2015 – current	Adjunct Associate Professor, Dept. of Biomedical Engineering, IUPUI
2015 – 2017	Adj. Associate Professional Specialist, Aero and Mechanical Eng., Notre Dame
2012 – 2015	Associate Professional Specialist, Aero and Mechanical Eng., Notre Dame
2005 -- 2012	Assistant Professor, Aerospace and Mechanical Engineering, Notre Dame
1990 - 1997	R&D/Manufacturing Development Engineer, Hewlett Packard, San Diego, CA

c. Recent Product

Bonitsky C.M., Selep M.J., McGann M.E., Ovaert T.C., Trippel S.B. and **Wagner D.R.** The Effect of Impact and Genipin Crosslinking on the Friction, Wear and Biochemical Degradation of Articular Cartilage. *Journal of Orthopaedic Research* 2017, 35(3): 558-565.

Weiss-Bilka H.E., McGann M.E., Meagher M.J., Roeder R.K. and **Wagner D.R.** The Endochondral Response of Human Adipose-Derived Stem Cells in an Ectopic Model: A Comparison of Pellet and Alginate Bead Culture Methods. *Journal of Tissue Engineering and Regenerative Medicine* 2017.

Sharma P., Bolten Z.T., **Wagner D.R.** and Hsieh A.H. Deformability of Human Mesenchymal Stem Cells is Dependent on Vimentin Intermediate Filaments. *Annals of Biomedical Engineer Annals of Biomedical Engineering* 2017, 45(5):1365-1374.

Steward A.J., Kelly D.J., **Wagner D.R.** Purinergic Signaling Regulates the Chondrogenic Response of Mesenchymal Stem Cells to Hydrostatic Pressure. *Tissue Engineering Part A 2016,* 22(11-12): 831-839. DOI: 10.1089/ten.tea.2015.0047

Meagher M.J., Weiss-Bilka H.E., Best M.E., Boerckel J.D., **Wagner D.R.**, Roeder R.K. Acellular Hydroxyapatite-collagen Scaffolds Support Angiogenesis and Osteogenic Gene Expression in an Ectopic Murine Model: Effects of Hydroxyapatite Volume Fraction. *Journal of Biomedical Materials Research Part A* 2016, 104(9):2178-2188.

McGann M.E., Bonitsky C.M., Jackson M., Ovaert T.C., Trippel S.B. and **Wagner D.R.** Genipin Crosslinking of Cartilage Enhances Resistance to Biochemical Degradation and Mechanical Wear. *Journal of Orthopaedic Research* 2015, 33(11):1571-9. DOI: 10.1002/JOR.22939

Kane, R.J., Weiss-Bilka, H.E., Meagher M.J., Liu, Y.*, Gargac J.C., Niebur G.L., **Wagner D.R.** and Roeder R.K. Hydroxyapatite Reinforced Collagen Scaffolds with Improved Architecture and Mechanical Properties. *Acta Biomaterialia* 2015, 17:16-25. DOI: 10.1016/j.actbio.2015.01.031

Steward A.J., Kelly D.J., **Wagner D.R.** Calcium Signaling Regulates the Chondrogenic Response of Mesenchymal Stem Cells to Hydrostatic Pressure. *European Cells and Materials* 2014, 28:358-71. PMID: 25350251.

McGann M.E., Bonitsky C.M., Ovaert T.C. **Wagner, D.R.** The Effect of Collagen Crosslinking on the Biphasic Poroviscoelastic Cartilage Properties Determined from a Semi-Automated Microindentation Protocol for Stress Relaxation. *Journal of the Mechanical Behavior of Biomedical Materials* 2014, 34:264-272. DOI: 10.1016/j.jmbbm.2014.02.013

Steward A.J., **Wagner D.R.**, Kelly D.J. A Role for Integrin Binding and Microtubule Reorganization in Mesenchymal Stem Cell Mechanotransduction. *Journal of Mechanical Behavior of Biomedical Materials* 2014, 38:174-182. DOI: 10.1016/j.jmbbm.2013.07.020

d. Synergistic Activities

- Journal Review: Ad-hoc reviewer for over 30 scientific journals in the fields of mechanical engineering, biomechanics, biomedical engineering, orthopaedics and biosciences.
- Grant review: Served as a reviewer for grant applications submitted to NIH, NSF and VA, as well as federal agencies in the Netherlands, Canada, New Zealand and Chile.
- Engineering outreach: Invited speaker for Introduction to Engineering Program at Notre Dame, a summer program for high school students, 2008, 2012 and 2014. Invited speaker (with former grad student Andrew Steward), Biomedical Sciences Program, Mishawaka High School, 2014. Invited Speaker, ND ASME student section. Volunteer speaker, Expanding Your Horizons, Science and Math conference for middle school girls.
- Prepared and taught courses in the areas of basic mechanics, advanced mechanics, orthopaedic biomechanics, cell mechanics and tissue engineering.
- Advisory Board, Indiana Zeta chapter of Tau Beta Pi, 2017 – current. Member of American Society of Mechanical Engineers (ASME), Orthopaedic Research Society (ORS), Tau Beta Pi.
- National Science Foundation Fellow, 1998 – 2001.

e. Collaborators and Other Affiliations

1. **Collaborators** – total number of collaborators and co-editors (13)

Uma Sankar (Indiana University School of Medicine), Jiliang Li (Indiana University Purdue University Indianapolis), Joel Boerkel (University of Pennsylvania), Christopher T. Chen (University of Texas Arlington), Tien-Min Gabriel Chu (Indiana University School of Dentistry), Adam Hsieh (University of Maryland), Melissa Kacena (University of Indiana School of Medicine), Daniel Kelly (Trinity College Dublin, Ireland), Glen Niebur (University of Notre Dame), Timothy Ovaert, (University of Notre Dame), Ryan Roeder (University of Notre Dame), Stephen Trippel (University of Indiana School of Medicine), Cari Whyne (Sunnybrook Research Institute, Toronto, Canada).

2**. Graduate Advisors** – total number of graduate advisors (2)

Dr. Jeffrey C. Lotz (U. of California San Francisco) and Dr. James Casey (U. of California Berkeley)

3. **Postdoctoral Sponsors** – total number of postoctorals sponsors (2)

Drs. Michael T. Longaker and Dennis R. Carter (Stanford University)

4. **Thesis Advisor and Postdoctoral-Scholar Sponsor**

MS students: S. Chandwadkar (current), M.J. Hossain (current), G. Hosseini (current)
PhD Students: N.T. Hollingsworth (2011, Kimberly Clark), A. Vahdati (2012, BD), M.E. McGann (2013, Purdue Polytechnic Institute, South Bend), H.E. Weiss-Bilka (2013), A.J. Steward (2014, Zimmer Biomet), C.M. Bonitsky (2015, Curtiss-Wright Corp.), A. Joukar (current), H. Noori (current).
Postdoctoral-Scholars: C.M. Kemmis (2007 – 2010, Winston-Salem State University), Y. Liu (2010 – 2011, Innovative Elements LLC), I.N. Aguilar (current), David Kahn (current).

Total Number of Graduate Students Advised: 11 (3 MS and 8 PhD)
Total Number of Postdoctoral Scholars Sponsored: 4

Xiaoliang (Shawn) Wei, Ph.D.
Indiana University Purdue University Indianapolis (IUPUI)

A. Education and Training

B.S. in Materials Science & Engineering, University of Science and Technology of China, Hefei, China, 2003

Ph.D. in Chemistry, Brown University, Providence, RI, 2009

B. Professional Experience

2018-present Assistant Professor of Department of Mechanical & Energy Engineering, IUPUI
2017-2018 Scientist III, Pacific Northwest National Laboratory
2013-2016 Scientist II, Pacific Northwest National Laboratory
2011-2013 Post Doctorate Research Associate, Pacific Northwest National Laboratory
2010-2011 Postdoctoral Research Associate, Case Western Reserve University
2009-2010 Research Associate, Brown University

C. Selected peer-reviewed publications

Five publications most related to the proposed project

Hollas, A., Wei, X.,* Murugesan, V., Nie, Z., Li, B., Reed, D., Liu, J., Sprenkle, V., and Wang, W., "A Nature-Inspired, Energy-Dense Phenazine-based Anolyte for Aqueous Organic Redox Flow Batteries" Nature Energy, under revision.

Duan, W., Huang, J., Kowalski, J. A., Shkrob, I. A., Vijayakumar, M., Walter, E., Pan, B., Yang, Z., Milshtein, J. D., Li, B, Liao, C., Zhang, Z., Wang, W., Liu, J., Moore, J. S., Brushett, F., Zhang, L., and Wei, X.,* "Wine-dark sea" in an organic flow battery: storing negative charge in 2,1,3-benzothiadiazole radicals leads to improved cyclability. ACS Energy Letters Vol. 2, Issue 5, 1156-1161, 2017.

Wei, X.,* Xu, W., Huang, J., Zhang, L., Walter, E., Lawrence, C., Vijayakumar, M., Henderson, W. A., Liu, T., Cosimbescu, L., Li, B., Sprenkle, V., and Wang, W., "Radical compatibility with nonaqueous electrolytes and its impact on an all-organic redox flow battery" Angewandte Chemie International Edition, Vol. 54, Issue 30, 8684-8687.

Wei, X., Cosimbescu, L., Xu, W., Hu, J., Vijayakumar, M., Feng, J., Hu, M. Y., Deng, X., Xiao, J., Liu, J., Sprenkle, V., and Wang, W., "Towards high-performance nonaqueous redox flow electrolyte via ionic modification of active species" Advanced Energy Materials Vol. 5, Article 1400678, 2015.

Wei, X., Xu, W., Vijayakumar, M., Cosimbescu, L., Liu, T., Sprenkle, V., and Wang, W., "TEMPO-based catholyte for high energy density nonaqueous redox flow batteries" Advanced Materials, Vol. *26*, Issue 45, 7649-7653, 2014.

Five other important publications

Wei, X.,* Pan, W., Duan, W., Hollas, A., Yang, Z., Li, B., Nie, Z., Liu, J., Reed, D., Wang, W., and Sprenkle, V., "Materials and Systems for Organic Redox Flow Batteries: Status and Challenges" ACS Energy Letters, Vol. 2, Issue 9, 2187-2204, 2017.

Zhang, J., Yang, Z., Shkrob, I. A., Assary, R. S., Tung, S., Silcox, B., Duan, W., Zhang, J., Liao, C., Zhang, Z., Wang, W., Curtiss, L. A., Thompson, L., Wei, X.,* and Zhang, L., "Annulated dialkoxybenzenes as catholyte materials for nonaqueous redox flow batteries: achieving high chemical stability through bicyclic substitution" Advanced Energy Materials, Vol. 7, Issue 21, Article 1701272, 2017.

Wei, X.,* Duan, W., Huang, J., Zhang, L., Li, B., Reed, D., Sprenkle, V., Xu, W., Wang, W., "A stable, high-current nonaqueous organic redox flow battery" ACS Energy Letters, Vol. 1,

Issue 4, 705-711, 2016.

Duan, W., Vemuri, R. S., Milshtein, J. D., Laramie, S., Dmello, R. D., Huang, J., Zhang, L., Hu, D., Vijayakumar, M.,Wang, W., Liu, J., Thompson, L., Smith, K., Moore, J. S., Brushett, F. R., Wei, X.,* "A symmetric organic-based nonaqueous redox flow battery and its state of charge diagnostics by FTIR" Journal of Materials Chemistry A, Vol. 4, Issue 15, 5448-5456, 2016.

Wei, X., Nie, Z., Luo, Q., Li, B., Chen, B., Simmons, K., Sprenkle, V., and Wang, W., "Nanoporous polytetrafluoroethylene/silica composite separator as a high-Performance all-vanadium redox flow battery membrane" Advanced Energy Materials, Vol. 3, Issue 9, 1215-1220, 2013.

Patents

Li, B., Liu, T., Wei, X., Nie, Z., Wang, W., Liu, J., Sprenkle, V., Aqueous Electrolytes for Redox Flow Battery Systems. US patent # 20160308233.

Wang, W., Xiao, J., Wei, X., Liu, J., Sprenkle, V., Hybrid anodes for redox flow batteries. US patent # 20140141291.

Li, B., Wei, X., Nie, Z., Wang, W., Liu, J., Sprenkle, V., High-energy-density nonaqueous flow batteries having iodine-based species. US patent 20150349369.

Xu, W., Cosimbescu, L., Wei, W., Wang, W., Sprenkle, V., Ionic conductive chromophores and nonaqueous redox flow batteries. US patent # 20130273459.

Li, B., Wei, X., Luo, Q., Nie, Z., Wang, W., Sprenkle, V., Composite separators and redox flow batteries based on porous separators. US Patent # 20140127542.

D. Synergistic Activities

1. Served as the Institutional PI for Joint Center for Energy Storage Center (JCESR)

2. Served as a symposium lead organizer for 2018 MRS Spring Meeting

3. Served as advisory board members for Scientific Reports and Cogent Engineering

E. Collaborators & Other Affiliations

(i) Collaborators and co-editors

Dr. Wei Wang, Vincent Sprenkle, Jun Liu, Pacific Northwest National Laboratory; Prof. Jeffrey S. Moore, Kyle Smith, University of Illinois Urbana-Champaign; Prof. Fikile R. Brushett, Massachusetts Institute of Technology; Dr. Brett Helms, Kristin Persson, Lawrence Berkeley National Laboratory; Dr. Travis Anderson, Sandia National Laboratory; Prof. Levi T. Thompson, University of Michigan Ann Arbor; Dr. Zhengcheng Zhang, Lu Zhang, Ilya A. Shakrob, Argonne National Laboratory.

(ii) Graduate and Postdoctoral Asvisors

Prof. Matthew B. Zimmt, Brown University
Prof. Lei Zhu, Case Western Reserve University
Dr. Wei Wang, Pacific Northwest National Laboratory
Dr. Gary Z. Yang, UniEnergy Technologies, Inc.

(iii) *Thesis Advisor and Postgraduate Scholar Sponsor*

Dr. Wentao Duan, Energy Storage Systems, Inc.
Dr. Rama S. Vemuri, Pacific Northwest National Laboratory
Dr. Zheng Yang, Pacific Northwest National Laboratory

Jian Xie, Ph.D.
Professor, Department of Mechanical & Energy Engineering
Purdue School of Engineering and Technology
Indiana University-Purdue University Indianapolis (IUPUI)
Indianapolis, Indiana

Professional Preparation:

Tianjin University, China	Chemical /Electrochemical Engineering	B.S.	1982
University of South Dakota	Chemistry/Electrochemistry	M.S.	1996
Miami University	Chemistry/Electrochemistry	Ph.D.	1999
Los Alamos National Lab	Materials Science and Technology	Postdoc	2001–2004

Appointments:

2016–present	Professor, Department of Mechanical & Energy Engineering, IUPUI, Indianapolis, IN
2013–2016	Associate Professor, Department of Mechanical Engineering, IUPUI, Indianapolis, IN
2007–2013	Assistant Professor, Department of Mechanical Engineering, IUPUI, Indianapolis, IN
2007	Principal Research Scientist, Battelle Memorial Institute, Columbus, OH
2005–2006	Senior Electrochemist, Cabot Corp, Albuquerque, NM
1999–2000	System Engineer, General Motors Advanced Technology Division, Indianapolis, IN

Publications

Relevant Publications (*corresponding author, **graduate/undergraduate co-authors):

1. Yadong Liu, Qi Liu, Le Xin, Yuzi Liu, Fan Yang**, Eric A. Stach and Jian Xie*, "Making Li-Metal Electrodes Rechargeable by Controlling the Direction of Dendrite Growth", ***NATURE ENERGY*** 2, 17083 (2017) | DOI: 10.1038/nenergy.2017.83 | www.nature.com/natureenergy.
2. Qi Liu**, Zhe-Fei Li, Yadong Liu, Hangyu Zhang**, Yang Ren, Chengjun Sun, Wenquan Lu, Yun Zhou**, Lia Staciu, Eric A. Stach and Jian Xie*, "Graphene Modified Nanostructured V_2O_5 Xerogel With Extraordinary Electrochemical Performance for Li-ion Batteries" ***Nature Communications***, 2015, doi:10.1038/ncomms7127
3. Z. Li, H. Zhang, Q. Liu**, Y. Liu, L. Stanciu, and **J. Xie****, "Novel pyrolyzed polyaniline-grafted silicon nanoparticles encapsulated in graphene sheets for Li-ion battery anodes," ACS Applied Materials & Interfaces, 6(8), 5996–6002, 2014.
4. Q. Liu**, H. He**, Z. Li, Y. Liu, Y. Ren, W. Lu, J. Lu, E. Stach, and **J. Xie***, "Rate-dependent, Li ion insertion/deinsertion behaviour of $LiFePO_4$ cathodes in commercial 18650 $LiFePO_4$ cells," ACS Applied Materials and Interfaces, 6, 3282-3289, 2014.
5. Q. Liu**, Y. Liu, C.-J. Sun, Z. Li,Y. Ren, W. Lu, E. A. Stach and **J. Xie***, "The structural evolution of V_2O_5 nanocrystals during electrochemical cycling studied using in operando synchrotron techniques," Electrochimica Acta, 136, 318-322, 2014

Other Significant Publications (*denotes undergraduate co-authors and **denotes corresponding authors):

1. Z. Li, H. Zhang, Q. Liu**, Y. Liu, L. Stanciu, and **J. Xie***, "Covalently-grafted polyaniline on graphene oxide sheets for high performance electrochemical supercapacitors," Carbon, 71, 257, 2014.
2. Le Xin, Fan Yang **, Zhe-Fei Li, Somaye Rasouli**, Paulo J. Ferreira, Cheng-Jun Sun, Yu-Zi Liu, and Jian Xie*, "**Understanding of Pt nanoparticle anchoring on graphene supports through surface functionalization**", ACS Catalysis, 2015, (Impact factor: 9.312), **DOI:** 10.1021/acscatal.5b02722.
3. Z. Li, H. Zhang, Q. Liu**, L. Sun**, L. Stanciu, and **J. Xie****, "Fabrication of high-surface-area graphene/polyaniline nanocomposites and their application in supercapacitors," ACS Applied Materials & Interfaces, 5, 2685−2691, 2013.

4. M. Wang, Q. Liu**, Z. Li, H. Sun, E. Stach, and **J. Xie****, "Structural modification of graphene sheets to create a dense network of edge sites," Journal of Physical Chemistry Letters, 4, 1484–1488, 2013.
5. Zhe-Fei Li, Le Xin, Fan Yang**, Yadong Liu, Yuzi Liu, Hangyu Zhang, Lia Stanciu, and Jian Xie, "Hierarchical Polybenzimidazole-grafted Graphene/Carbon Hybrids as Supports for Pt Nanoparticle Catalysts with Excellent PEMFC Performance" ***NanoEnergy,*** 16 (2015) 281-29; doi:10.1016/j.nanoen.2015.06.031.

Synergistic Activities:

- Served as a panelist for proposal reviews for the National Science Foundation (NSF) Energy for Sustainability Program (PD07-7644) and Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program
- Served as a panelist for proposal reviews for the Department of Energy (DOE) Advanced Research Projects Agency - Energy (ARPA-E), Fuel Cell Technology Office, Small Business Voucher Pilot Program
- Served as a panelist for the Fuel Cell Technology Office annual program merit review.
- Serve as a review board member for several publications including Nature Communications, Nature Energy, Electrochemical Society, Electrochemical and Solid-State Letters, Journal of Power Sources, Electrochim. Acta, International Journal of Hydrogen Energy, Catalysis, Energy and Environment, Industrial & Engineering Chemistry Research, and Topics in Catalysis.
- Member of Electrochemical, American Chemical, and Materials Research Societies.

Collaborators and Other Affiliations:

Palmen Atanassov, Associate Professor, (University of New Mexico, Albuquerque, NM), Douglas Blom (Oak Ridge National Laboratory, Oak Ridge, TN), Rodney Borup (Los Alamos National Laboratory, Los Alamos, NM), Fernando Garzon (Los Alamos National Laboratory, Los Alamos, NM), Derek Ho (National Institute of Standards and Technology (NIST), Gaithersburg, MD), Q. X. Jia (Los Alamos National Laboratory, Los Alamos, NM), Deborah Meyers (Argonne National Laboratory, Lemont, IL), Andrew Saab (Lawrence Livermore National Laboratory, Livermore, CA), Eric Stach (Brookhaven National Laboratory, Upton, NY), Jia Wang (Brookhaven National Laboratory, Upton, NY), and Thomas Zawodzinski (Case Western Reserve University, Cleveland, OH)

Graduate Advisor and Postdoctoral Sponsor:

Ph.D. Advisor – Professor Thomas Riechel, Ph.D., Miami University, Oxford, OH
Postdoctoral Sponsor – Thomas Zawodzinski, Los Alamos National Laboratory, Los Alamos, NM

Graduate and Postdoctoral Advisees Within the Last 5 Years:

Graduate Students:
Fan Xue (Cummins), Hao He (Hunan University), Lili Sun (affilitation unknown), Qi Liu (current), Yuan Zhou (current), Fan Yang (current), and Sichao Huang (current)
Postdoctoral Advisees:
Lihong Huang (Chengdu University of Technology), Meixian Wang (Graftech), Yadong Liu (affiliation unknown), Chuan-kun Jia (affiliation unknown), Zhefei Li (current), and Le Xin (current)
Total Number of Graduate Students Advised: 7
Total Number of Postdoctoral Scholars Sponsored: 6

Undergraduate Students Supervised via MURI Program (Since 2010):

Seth Simonson, Derek Vlek, Trevor Zike, Lili Farhandi , Leon Charles Shagoury, Kyle Benjamin Burkholder, Derrick Buck, Daric Ethan Fitzwater, Theary Pich, Jason Wood, Michael Stanton, and Ryan Patterson, Mohamed Mohamed, Meskerem Etebo, and Mesafint Fanuel

Shengfeng Yang, Ph.D.

Department of Mechanical Engineering, Indiana University Purdue University Indianapolis
E-mail: yangsf@iupui.edu, Tel: (317) 278-4306

a. Professional Preparation

Huazhong Univ. of Sci. & Tech.	China	Engineering Mechanics	B.S.	2008
Huazhong Univ. of Sci. & Tech.	China	Solid Mechanics	M.S.	2010
University of Florida	FL, USA	Mechanical Engineering	Ph.D.	2014
University of California, San Diego	CA, USA	NanoEngineering	Postdoctor	2015-2017

b. Appointments

2017 – present	Assistant Professor	Indiana University Purdue University Indianapolis

c. Products

PRODUCTS MOST CLOSELY RELATED

1. S. Yang, N. Zhang, & Y. Chen. (2015) Concurrent atomistic–continuum simulation of polycrystalline strontium titanate. *Philosophical Magazine*, 95(24), 2697-2716
2. S. Yang, Y. Chen. (2015) Concurrent atomistic and continuum simulation of bi-crystal strontium titanate with tilt grain boundary, *Proceedings of The Royal Society A*, 471, 20140758
3. S. Yang, L. Xiong, Q. Deng, & Y. Chen. (2013) Concurrent atomistic and continuum simulation of strontium titanate. *Acta Materialia*, 61(1), 89-102
4. S. Yang and Y. Chen. "Concurrent Atomistic-Continuum Simulation of Defects in Polyatomic Ionic Materials" In *Multiscale Materials Modeling for Nanomechanics*, Springer, 2016, 261-296
5. X Chen, W Li, L Xiong, Y Li, S. Yang, Z Zheng, DL McDowell, Y Chen. (2017) Ballistic-diffusive phonon heat transport across grain boundaries. *Acta Materialia* 136, 355-365

OTHER SIGNIFICANT PRODUCTS

1. N. Zhang, S. Yang, L. Xiong, Y. Hong, & Y. Chen. (2016) Nanoscale toughening mechanism of nacre tablet. *Journal of the Mechanical Behavior of Biomedical Materials*, 53, 200-209
2. H. Wang, S. Yang. (2016). Modeling and analysis of the thermal effects of a circular bimorph piezoelectric actuator. *Applied Optics*, 55(4), 873-878.
3. Z. Zheng, X. Chen, B. Deng, A. Chernatynskiy, S. Yang, L. Xiong, & Y. Chen. (2014) Phonon thermal transport through tilt grain boundaries in strontium titanate. *Journal of Applied Physics*, 116, 073706

4. S. Yang, X. Yang, A. Yin, & W. Jiang. (2012) Three-dimensional numerical evaluation of influence factors of mechanical properties of the asphalt mixture. *Journal of Mechanics*, 28(03), 569-578
5. A. Yin, X. Yang, S. Yang, & W. Jiang. (2011) Multiscale fracture simulation of three-point bending asphalt mixture beam considering material heterogeneity. *Engineering Fracture Mechanics*, 78(12), 241-2428

d. Synergistic Activities

1. **Reviewer for Journals** (*Nature Communications, Acta Materialia, Journal of Applied Physics, Journal of Mechanics, Materials Science & Engineering A, Journal of Materials Research, Journal of Sandwich Structures and Materials, Luminescence: The Journal of Biological and Chemical Luminescence, International Conference on Materials Science and Engineering, Global Conference on Polymer and Composite Materials, Continuum Mechanics and Thermodynamics*)
2. **Membership:** *(i) American Society of Mechanical Engineers (ASME), (ii) Society of Engineering Science (SES), (iii) The Minerals, Metals and Materials Society (TMS)*

Biographical Sketch

Huidan (Whitney) Yu, PhD

PROFESSIONAL PREPARATION

- Zhejiang Normal University, Jinhua, China, Physics, BS, 1984
- Peking University, Beijing, China, Physics, PhD, 2001
- Texas A&M University, College Station, TX, Aerospace Engineering, PhD, 2004,
- Los Alamos National Laboratory, Los Alamos, NM, Computational Fluid Dynamics, 2005-2009
- The Johns Hopkins University, Baltimore, MA, Computational Fluid Dynamics, 2009-2011

APPOINMENTS

- 2017 – present, Associate Professor, Indiana University-Purdue University, Indianapolis (IUPUI)
- 2011 - 2017, Assistant Professor, IUPUI
- 2009 - 2011, Keck Foundation Postdoc Fellow, The Johns Hopkins University
- 2005 - 2009, Postdoc Research Associate, Los Alamos National Laboratory
- 2001 - 2004, Research Assistant, Texas A&M University
- 2000 - 2001, Research Assistant, The Pennsylvania State University
- 1984 – 2002, faculty, Zhejiang Normal University (China)

PUBLICATIONS (*Corresponding author)

Most closely related to the proposed project

1. R. Chen, **H. Yu***, L. Zhu, T. Lee, and R. M. Patil, Spatial and Temporal Scaling of Unequal Microbubble Coalescence, The AIChE Journal, 63(4) (2017) 1441-1450.
2. R. Chen, **H. Yu***, and L. Zhu, Effects of Initial Conditions on the Coalescence of Micro-bubbles, Journal of Mechanical Engineering Science, accepted.
3. S. An, **H. Yu***, and J. Yao, GPU-accelerated Volumetric Lattice Boltzmann Method for Porous Media Flow, Journal of Petroleum Science and Engineering, 156(2017)546-552.
4. **H. Yu**, X. Chen, Z. Wang, D. Deep, E. Lima, Y. Zhao, and S. D. Teague, Mass-conserved volumetric lattice Boltzmann method for complex flows with or without willfully moving boundaries, Phys. Rev. E, 89 (2014) 063304
5. S An, **H. Yu***, Z. Wang, R. Chen, B. Kapadia, J. Yao, Unified Mesoscopic Modeling and GPU-accelerated Computational Method for Image-based Pore-scale Porous Media Flows, International Journal of Heat and Mass Transfer, 115(2017)1192-1202.

Other significant publications

1. S. An, **H. Yu***, Z. Wang, R. Chen, B. Kapadia, J. Yao, Unified Mesoscopic Modeling and GPU-accelerated Computational Method for Image-based Pore-scale Porous Media Flows, International Journal of Heat and Mass Transfer, 115(2017)1192-1202.
2. Z. Wang, Y. Zhao, A. P. Sawchuk, M. C. Dalsing, and **H. Yu*,** GPU Acceleration of

Volumetric Lattice Boltzmann Method for Patient-specific Computational Hemodynamics, Computer & Fluids, 115(2015)192-200.
3. **H. Yu**, R. Chen, H. Wang, Z. Yuan, Y. Zhao, Y. An, Y. Xu, and L. Zhu, GPU accelerated lattice Boltzmann simulation for rotational turbulence, Computer & Mathematics with Applications, 67(2) (2014) 437-451
4. **H. Yu** and C. Meneveau, "Lagrangian Refined Kolmogorov Similarity Hypothesis for Gradient Time-evolution in Turbulent Flows", Physical Review Letters, 104 (2010), 084502.
5. **H. Yu**, R. Chen, H. Wang, Z. Yuan, Y. Zhao, Y. An, Y. Xu, and L. Zhu, GPU accelerated lattice Boltzmann simulation for rotational turbulence, Computer & Mathematics with Applications, 67(2) (2014) 437-451

SYNERGISTIC ACTIVITIES

1. Serving as the Chair of the 30th International Conference on Parallel Computational Fluid Dynamics, May 14-17, 2018, Indianapolis, Indiana, USA
2. Serving as an active member of IU-MSI STEM Initiative to establish long-term, mutually beneficial, highly interactive relationships between Indiana University and the Historically Black Colleges and Universities (HBCUs). Exchange of Faculty with UC Merced (Minority Serving Institutions) has been scheduled on Nov. 19-22 for research collaboration.
3. Developed a new graduate course, ME60101, entitled Computational Modeling of Turbulence.
4. Participated in campus outreach "Minority Engineering Advancement Program (MEAP)", hosting one afternoon session for presentation and demonstration of human blood flows to 7th-8th pre-college students in summer 2014 and 2016 respectively
5. Supervising/Supervised 3 PhD, 6 MS, 3 BS thesis students, hosting or hosted 3 visiting scholars, 3 international visiting graduate students to conduct research projects since 2011

Jing Zhang, Ph.D.
Associate Professor
Department of Mechanical Engineering, Indiana University – Purdue University Indianapolis, Indianapolis, IN 46202
Tel: (317) 278-7186; Fax: (317) 274-9744; E-mail:jz29@iupui.edu,
Website: www.engr.iupui.edu/~jz29

Professional Preparation:

U. of Science and Technology, China	Metal Forming	B.S. (with honors)	1996
Beijing U. of Aero. & Astro., China	Manufacturing Engineering	B.S. (with honors)	1999
Drexel University, PA	Materials Science/Engineering	Ph.D.	2004
Rensselaer Polytechnic Institute, NY	Materials Science	Postdoc	2004–2006

Appointments:

2011–present	Associate Professor (2016- present), Assistant Professor (2011-2016), Department of Mechanical Engineering, IUPUI, IN
2005–2011	Assistant Professor, Department of Mechanical Engineering, University of Alaska Fairbanks, AK
2008	Research Scientist, U.S. Air Force Research Laboratory (AFRL), Wright-Patterson Air Force Base, OH
2006–2008	Affiliated Faculty, Arctic Region Supercomputing Center, AK
2000–2004	Research/Teaching Assistant, Drexel University, PA

Products:

Relevant Publications:

1. Xingye Guo, Yi Zhang, Yeon-Gil Jung, Li Li, James Knapp, **Jing Zhang**, Ideal Tensile Strength and Shear Strength of ZrO2(111)/Ni(111) Ceramic - Metal Interface: A First Principle Study, Materials & Design , 112, pp. 254-262, 2016
2. Sung-Hoon Jung, Zhe Lu, Yeon-Gil Jung, Dowon Song, Ungyu Paik, Baig-Gyu Choi, In-Soo Kim, Xingye Guo, **Jing Zhang**, Thermal durability and fracture behavior of layered Yb-Gd-Y-based thermal barrier coatings in thermal cyclic exposure, Surface and Coatings Technology, (http://dx.doi.org/10.1016/j.surfcoat.2016.09.032), 2016
3. **Jing Zhang**, Xingye Guo, Yeon-Gil Jung, Li Li, James Knapp, Lanthanum Zirconate Based Thermal Barrier Coatings: A Review, Surface and Coatings Technology, (http://dx.doi.org/10.1016/j.surfcoat.2016.10.019), 2016
4. Dowon Song, Ungyu Paik, Xingye Guo, **Jing Zhang**, Ta-Kwan Woo, Zhe Lu, Sung-Hoon Jung, Je-Hyun Lee, Yeon-Gil Jung, Microstructure design for blended feedstock and its thermal durability in lanthanum zirconate based thermal barrier coatings, Surface and Coatings Technology , (http://dx.doi.org/10.1016/j.surfcoat.2016.07.112), 2016
5. Xingye Guo, Zhe Lu, Yeongil Jung, Li Li, James Knapp, and **Jing Zhang**, Thermal properties, thermal shock and thermal cycling behavior of lanthanum zirconate based thermal barrier coatings, Metallurgical and Materials Transactions E , Vol. 3, pp. 64-70, 2016

Other Significant Publications:

6. Yi Zhang, Linmin Wu, Xingye Guo, Yeon-Gil Jung, **Jing Zhang**, Molecular Dynamics Simulation of Electrical Resistivity in Sintering Process of Nanoparticle Silver Inks, *Computational Materials Science*, Vol. 125, pp. 105-109, 2016

7. Yi Zhang, **Jing Zhang**, Sintering Phenomena and Mechanical Strength of Nickel Based Materials in Direct Metal Laser Sintering Process - A Molecular Dynamics Study, *Journal of Materials Research* , 31(15) pp. 2233-2243, 2016
8. **Jing Zhang**, A. Zavaliangos, Discrete Finite Element Simulation of Thermoelectrical Phenomena in Spark Plasma Sintering, *Journal of Electronic Materials*, Vol. 40, Issue 5, pp. 873-878, 2011
9. Yi Zhang, Linmin Wu, Hazim El-Mounayri, **Jing Zhang**, Molecular Dynamics Study of the Strength of Laser Sintered Iron Nanoparticles, 43rd Proceedings of the North American Manufacturing Institution of SME, *Procedia Manufacturing*, pp. 296-307, 2015
10. Linmin Wu, **Jing Zhang**, Ab initio study of anisotropic mechanical properties of $LiCoO_2$ during lithium intercalation and deintercalation process, *Journal of Applied Physics*, 118, 225101, 2015

Synergistic Activities:

- Lead guest editor of "Advanced Coatings for Energy and Environmental Applications – Design, Processing, Properties, and Performance", in Special Issue of Coating and Surface Technology (Elsevier), 2016
- Lead-organizer of symposium "Recent Development in Additive Manufacturing: Process and Equipment Development and Applications" in Materials Science & Technology 2016 (MS&T16), Salt Lake City, UT, 2016
- Lead-organizer of symposium "Advanced Coatings for Energy and Environmental Applications" in Materials Science & Technology 2015 (MS&T15), Pittsburgh, PA, 2015.
- Selected awards: U.S. Air Force Summer Faculty Fellow, U.S. Air Force 2008; National Science Foundation Nanomechanics Institute Fellow, 2008; Alaska NSF/EPSCoR Early CAREER Award, 2008; Best Poster Award, TMS Meeting, 2004.
- Proposal review panelist: NSF (CMMI, DMR, GRFP), DOE, ARPA-E, EPA

Graduate Advisor and Postdoctoral Sponsor:

Ph.D. Advisor – Antonios Zavaliangos, Drexel University
Postdoc Sponsor – Timothoy Cale, Rensselaer Polytechnic Institute

Total Number =2

Graduate and Postdoctoral Advisees within the Last 5 Years:

Graduate Students:

Tushar Bakhtiani (M.S., SRG Global), Michael Golub (M.S., current), Yanhong Gu (Ph.D., Beijing Inst. of Petrochemical Technology), Xingye Guo (Ph.D. current), Jillian Ladegard (M.S., Jacobs Engineering), Weng Hoh Lee (M.S., current), Jiayang Liu (M.S. Cummins), Patricia Ruiz Maldonado (M.S., Alyeska Pipeline Service Company), Dustin Ray (M.S., U. of Alaska Fairbanks), Jason Rowland (M.S., Lifewater Engineering Company), Linmin Wu (Ph.D., current), Hanyin Zhang (M.S., current), Wei Zhang (M.S., Michigan State University), Yi Zhang (Ph.D. current), Yongjun Zhang (Ph.D., Applied Ceramics Inc.).

Total Number of Graduate Students Advised = 15

Likun Zhu
Associate Professor of Mechanical Engineering
Indiana University-Purdue University Indianapolis (IUPUI)

Professional Preparation

Tsinghua University, Beijing, China	Mechanical Engineering	B.S. 1998
Tsinghua University, Beijing, China	Mechanical Engineering	M.S. 2001
University of Maryland, College Park, MD	Mechanical Engineering	Ph. D. 2006
University of Illinois, Urbana, IL (postdoc)	Micro fuel cells	2006 - 2009

Appointments

2015-present, Associate Professor, Department of Mechanical Engineering, IUPUI
2009-2015, Assistant Professor, Department of Mechanical Engineering, IUPUI

Products

1. C. Lim, B. Yan, L. Yin, and **L. Zhu**, "Geometric characteristics of 3D reconstructed anode electrodes of lithium ion batteries", *Energies*, vol. 7, pp. 2558-2572, 2014.
2. B. Yan, C. Lim, L. Yin, and **L. Zhu**, "Simulation of heat generation in a reconstructed $LiCoO_2$ cathode during galvanostatic discharge", *Electrochimica Acta*, vol. 100, pp. 171–179, 2013.
3. B. Yan, C. Lim, L. Yin, and **L. Zhu**, "Three dimensional simulation of galvanostatic discharge of $LiCoO_2$ cathode based on x-ray nano-CT images", *The Journal of Electrochemical Society*, vol. 159, No. 10, pp. A1604-A1614, 2012.
4. C. Lim, B. Yan, L. Yin, and **L. Zhu**, "Simulation of diffusion induced stress using reconstructed electrodes particle structures generated by micro/nano-CT", *Electrochimica Acta*, vol. 75, pp. 279–287, 2012.
5. N. Mahootcheian Asl, J. Keith, C. Lim, **L. Zhu**, Y. Kim, "Inorganic solid/organic liquid hybrid electrolyte for use in Li-ion battery", *Electrochimica Acta*, vol. 79, pp. 8 - 16, 2012.
6. J. Kim, R. Vijaya, **L. Zhu**, Y. Kim, "Improving electrochemical properties of porous iron substituted lithium manganese phosphate in additive addition electrolyte", *Journal of Power Sources*, vol. 275, pp. 106 – 110, 2015.
7. Y. Cao, J. Bontrager-Singer, **L. Zhu**, "A 3D microfluidic device fabrication method using thermopress bonding with multiple layers of polystyrene film", *Journal of Micromechanics and Microengineering*, vol. 25**,** 065005, 2015.
8. Y. Zhang, J. Han, **L. Zhu**, M. A. Shannon, J. Yeom, "Soft lithographic printing and transfer of photosensitive polymers: Facile fabrication of free-standing structures and patterning fragile and unconventional substrates", *Journal of Micromechanics and Microengineering*, vol. 24 (2014) 115019.
9. H. Hu, V. V. Swaminathan, M. Zamani Farahani, G. Mensing, J. Yeom, M. A. Shannon, **L. Zhu**, "Hierarchically structured re-entrant microstructures for superhydrophobic surfaces with extremely low hysteresis", *Journal of Micromechanics and Microengineering*, vol. 24, 095023, 2014.

10. V. Swaminathan, **L. Zhu**, B. Gurau, R. I. Masel and M. A. Shannon, "Integrated micro fuel cell with on-demand hydrogen production and passive control MEMS", *Microfluidics and Nanofluidics*, vol. 12, No. 5, pp. 735-749, 2012.

Synergistic Activities

- Mentored one postdoctoral research associate and nine graduate students. Mentored eleven undergraduate students from 2009 – present, including one female student, one African student and two Hispanic students. Some of the undergraduate students are authors in one journal paper and five conference presentations.
- Designed educational modules for the Indiana Energy Education Day (INEED) funded by ARPA-E and served in the INEED summer camp in summer 2012.
- Developed a new online renewable energy course, "Renewable Energy and Fuel Cells", for Indiana Advanced Electric Vehicle Training and Education Consortium (I-AEVtec) in spring 2011.
- Served as a panelist on 4 panels at the National Science Foundation from 2011 – present.
- Program committee member, the 13th international IEEE conference on nanotechnology, Beijing, China, August 5-9, 2013.

Collaborators & Other Affiliations

Collaborators and Co-Editors

- Agarwal, Mangilal , IUPUI; Chen, Lei, University of Mississippi; Chen, Zhongwei, University of Waterloo; De Carlo, Francesco, ANL; Farhad, Siamak, University of Akron; Feldhaus, Charles, IUPUI; Fu, Yongzhu, IUPUI; Fisher, Tim, Purdue University; Kim, Youngsik, Ulsan National Institute of Science and Technology in Korea; Litster, Shawn, Carnegie Mellon University; Meng, Desheng, UT Arlington; Mensing, Glennys, UIUC; Mullins, Buddie, UT Austin; Mutegi, Jomo, IUPUI; Na, Sungsoo, IUPUI; Rizkalla, Maher, IUPUI; Ryu, Jong Eun, IUPUI; Shannon, Mark, UIUC; Tovar, Andreas, IUPUI; Wang, Yong, Pennsylvania State University; Yan, Bo, Shanghai Jiaotong University; Yeom, Junghoon, Michigan State University; Yin, Leilei, UIUC; Yokota, Hiroki, IUPUI; Yu, Whitney, IUPUI [25 collaborators and co-authors]

Graduate Advisors and Postdoctoral Sponsors

1. Ph. D. Advisor: Dr. Don DeVoe, Department of Mechanical Engineering, University of Maryland, College Park, MD
2. Post-Doctoral Sponsor: Dr. Mark Shannon, University of Illinois, Urbana, IL
3. Post-Doctoral Sponsor: Dr. Rich Masel, Dioxide Materials Inc.

Thesis Advisor and Postgraduate-Scholar Sponsor

- Cheolwoong Lim (Millibatt, Inc.), Bo Yan (Shanghai Jiaotong University), Mahmoud Reza Zamani Farahani (PhD student at IUPUI), Spandana Gannavaram (Ford Motor Company), Yuanzhi Cao (PhD student at Purdue), Wen Chao Lee (Veneer Services LLC), Zhibin Song (unknown), Rani Vijaya (PhD student at the University of Tennessee), Tian Tian (Earlham College), Huixiao Kang(Valeo Inc.), Shuyi Zhou (IUPUI), Xinwei Zhou (PhD student, expected 2019), Byron Wolfe (MS student, expected 2019), Tianyi Li(PhD student, expected 2020), Yi Cui (PhD student, expected 2019) [4 PhD students, 9 master students, and 2 postgraduate scholars]

Appendix C.1 Letter of Support from the Dean of Engineering and Head of the School of Mechanical Engineering, Purdue University

PURDUE
UNIVERSITY

COLLEGE OF ENGINEERING

Mung Chiang
John A. Edwardson Dean of the College of Engineering

February 20, 2018

Jie Chen, Ph.D.
Professor and Chair
Department of Mechanical and Energy Engineering IUPUI
799 W. Michigan Street Indianapolis, IN 46202

Dear Professor Chen:

The College of Engineering and the School of Mechanical Engineering at Purdue's West Lafayette campus support the proposal to award a site-specific doctoral degree in Mechanical Engineering at Indiana University-Purdue University Indianapolis, with the understanding that both the diploma and the transcript will clearly state that the degree is awarded for work at the Indianapolis campus.

Faculty members in the School of Mechanical Engineering (ME) are ready to work with you and your faculty as you launch your program. Joint efforts could include such activities as research proposals, seminars, courses, and service on graduate student advisory committees. We have also recently agreed to the Graduate School's new policy that applicants to the ME graduate program at West Lafayette who could not be accommodated on this campus may apply to a graduate program at another Purdue campus at no charge.

We wish you success with this endeavor.

Mung Chiang, Ph.D.
John A. Edwardson Dean
College of Engineering

Anil Bajaj, Ph.D.
William E. and Florence E. Perry Head of Mechanical Engineering

Neil Armstrong Hall of Engineering | 701 W. Stadium Avenue | West Lafayette, IN 47907-2045
(765) 494-5346 | Fax: (765) 494-9321 | chiang@purdue.edu | https://engineering.purdue.edu

Appendix C.2 Industrial Supporting Letters

Rolls-Royce

Rolls-Royce Corporation
450 S. Meridian Street
Indianapolis, Indiana
46225 USA

Tel: 317 437-8768
Speed code: S-17
Email: Steven.R.Wellborn@Rolls-Royce.com

16 January 2018

David J. Russomanno, Ph.D.
Dean, Purdue School of Engineering and Technology, IUPUI
Indiana University-Purdue University Indianapolis
799 W. Michigan Street, ET 219 E
Indianapolis, IN 46202-5160

Dear Dr. Russomanno,

Rolls-Royce Corporation and its subsidiary Rolls-Royce North American Technologies, Inc. (LibertyWorks®) are pleased to submit this letter of support for the Indiana University Purdue University Indianapolis (IUPUI) establishment of a site-approved Ph.D. degree program in Mechanical Engineering. IUPUI graduates of the current Ph.D. program awarded through the West Lafayette campus hold important positions in our company. We have benefitted from the outstanding education they received. Clearly, you are ready to extend the current Ph.D. arrangement IUPUI has with the Purdue, West Lafayette campus to an IUPUI site-approved Ph.D. program.

Rolls-Royce has been particularly pleased with the benefits many of our employees have received through the opportunity to enhance their qualifications and contributions to our company's goals by studying at IUPUI. They are better prepared to assume higher levels of responsibility within the company. Moreover, this educational opportunity benefits Rolls-Royce as we seek to develop our own engineering leaders in their fields of expertise, and it allows us to retain our aspiring critical talent.

We also realize that your undergraduate degree students, the vast majority of whom are from Indiana, enjoy opportunities to have significant engagements in research and development. This experiential learning helps develop important skills that Indiana employers seek in new hires. Enriching the research environment by solidifying the Ph.D. degree program to complement the existing site-approved B.S. and M.S. programs at IUPUI will further improve the education and preparation of this important Indiana STEM population.

We believe that the requested site-approved status will further strengthen your overall engineering program by making it fully eligible for external funding opportunities that are restricted to those with site-approved doctoral degrees. All of us in Indiana's engineering community, and other contributors to our economy and quality of life, will share the benefits.

As a world leader in the design, manufacturing, and service of aircraft engines, Rolls-Royce is committed to providing products that offer the best combination of functionality and value to our customers. Rolls-Royce has shown dedication in supporting the development of a STEM talent pipeline, and we view the program proposed by IUPUI as in alignment with those shared aspirations.

If you have any questions, please contact Dr. Steve Wellborn at (317) 437-8768.

Sincerely,

Dr. Steve Wellborn
Head of Aero Thermal
Rolls-Royce Plc.

Lisa J. Teague
Head, Research & Technology – Indy
Rolls-Royce Corporation / LibertyWorks®

Rolls-Royce tracking number: 2018-006

Raytheon
Intelligence, Information and Services
Mission Support and Modernization (MSM)
6125 East 21st Street
Indianapolis, Indiana
46219-2058 USA

January 9, 2018

David J. Russomanno, Ph.D.
Dean, Purdue School of Engineering and Technology, IUPUI
Indiana University-Purdue University Indianapolis
799 W. Michigan Street, ET 219 E
Indianapolis, IN 46202-5160

Dear Dr. Russomanno,

I am pleased to write in strong support of your School's proposal for an IUPUI site-approved Ph.D. degree program in Mechanical Engineering. My colleagues at Raytheon and I have been pleased to witness the emergence of the School of Engineering and Technology at IUPUI as an excellent research and learning academic unit and key asset in our shared ambition to make Indiana a hub of discovery and innovation. IUPUI graduates of the current Ph.D. program awarded through the West Lafayette campus hold important positions in our company. We have benefitted from the outstanding education they received. Clearly, you are ready to extend the current Ph.D. arrangement IUPUI has with the Purdue, West Lafayette campus to an IUPUI site-approved Ph.D. program.

We have been particularly pleased with the benefits to our employees who have taken advantage of the opportunity to enhance their qualifications and contributions to our discovery mission by studying for the Ph.D. at IUPUI. They are well prepared to assume higher levels of responsibility in their research groups. Moreover, this training is beneficial to the company as we seek to develop our own engineers as leaders in their fields of inquiry and to retain the best and brightest.

We also realize that your undergraduate degree students (the vast majority of whom are from Indiana) enjoy opportunities to have significant engagements in research and development. This experiential learning helps develop important skills that Indiana employers seek in new hires. Enriching the research environment by solidifying the Ph.D. degree program to complement the existing site-approved B.S. and M.S. programs at IUPUI will further improve the education and preparation of your graduates.

I believe that approval of the site-approved status you are requesting will strengthen your programs even further by allowing them to participate in national rankings and by making them fully eligible for external funding programs that are restricted to those with site-approved doctoral degrees. All of us in Indiana's engineering community, and other contributors to our economy and quality of life, will share the benefits.

Sincerely,

Thomas J Stephens
IIS Engineering & Technology
Director, Hardware & Infrastructure
Raytheon Company

Candent Technologies
Turbine Power Systems

03 November 2017

Jie Chen, Ph.D.
Professor and Chair
Department of Mechanical Engineering
Purdue School of Engineering and Technology
Indiana University Purdue University Indianapolis

Subject: Local Ph.D. Programs for Small and Start-Up Business Employees

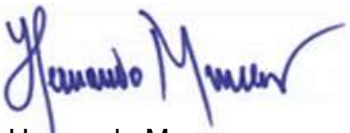
Dear Jie,

During the October 11th, 2017, ME Department Industrial Advisory Board meeting, one of the important topics discussed was the need for newly minted Ph.D. level graduates in the local area. As a small business owner, I frequently deal with many other small businesses, and a large number of them are engaged in high technology enterprises. In addition, technology incubators are spawning new high technology startup companies. What all these companies have in common is their quest for advancing technology and transitioning it into products or product solutions. However, in order to develop these advanced technologies these small companies need employees with a higher level of education and capability to understand very complex solutions using un-existing or undeveloped processes.

Small companies like EnerDel, located in Indianapolis, who is producing and developing advanced technology lithium batteries, could use Ph.D. level employees with the advanced knowledge of battery chemistries and capability to come up with the innovations required to make better progress in technology and product improvements. Other new small companies are engaged in developing new, better materials, systems, and cost effective processes capable of 3D printing metallic and non-metallic parts. The level of understanding and knowledge required in this case also calls for advanced degreed employees, typically Ph.D. level.

These small companies also have in common their inability to compete with major OEMs in recruiting PhDs. However, a potential and viable solution is for them to grow their own talent, which is only possible if local institutions such as IUPUI could offer the Ph.D. degree with the appropriate concentration, and in a manner that does not require the employees to be inordinately absent from work due to necessary travel out of the area to pursue their academic requirements. I wholeheartedly support any such program implementation at IUPUI, in particular the ME Department. An employee familiar with the product who can expand his or her knowledge and capability in critical subjects would be far more valuable to the business than newly minted graduates with no experience in the business.

Sincerely,



Hernando Munevar
President & CEO

Candent Technologies, Inc.
6107 W. Airport Blvd, Ste 190
Greenfield, IN 46140
Tel: 317-336-4478
www.candent-technologies.com

November 14, 2017

David J. Russomanno, Ph.D.
Dean, Purdue School of Engineering and Technology, IUPUI
Indiana University-Purdue University Indianapolis
799 W. Michigan Street, ET 219 E
Indianapolis, IN 46202-5160

Dear Dr. Russomanno,

I am pleased to write in strong support of your School's proposal for an IUPUI site-approved Ph.D. degree program in Mechanical Engineering. My colleagues at Cummins and I have been pleased to witness the emergence of the School of Engineering and Technology at IUPUI as an excellent research and learning academic unit and key asset in our shared ambition to make Indiana a hub of discovery and innovation. IUPUI graduates of the current Ph.D. program awarded through the West Lafayette campus hold important positions in our company. We have benefitted from the outstanding education they received. Clearly, you are ready to extend the current Ph.D. arrangement IUPUI has with the Purdue, West Lafayette campus to an IUPUI site-approved Ph.D. program.

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We also realize that your undergraduate degree students (the vast majority of whom are from Indiana) enjoy opportunities to have significant engagements in research and development. This experiential learning helps develop important skills that Indiana employers seek in new hires. Enriching the research environment by solidifying the Ph.D. degree program to complement the existing site-approved B.S. and M.S. programs at IUPUI will further improve the education and preparation of your graduates.

I believe that approval of the site-approved status you are requesting will strengthen your programs even further by allowing them to participate in national rankings and by making them fully eligible for external funding programs that are restricted to those with site-approved doctoral degrees. All of us in Indiana's engineering community, and other contributors to our economy and quality of life, will share the benefits.

Sincerely,

Wayne Eckerle

Vice President, Corporate Research and Technology

Wayne A. Eckerle
Vice President
Corporate Research and Technology

Cummins Inc.
1900 McKinley Ave., MC 50125
Columbus, IN 47201 USA

Phone 1 812 377 8615
cummins.com
wayne.a.eckerle@cummins.com