Purdue's Engineer of 2020
2011-2012 Seed Grant Program
Purdue University

Project Title:
Purdue's Engineer of 2020 Seed Grant Program: HUB-Enabled Curriculum Integration

Total Budget Requested: $40,000

Target Attribute(s) to be studied/implemented:

The proposed project will primarily enable the Knowledge Areas pillar within the Purdue Engineer 2020 framework. Specifically, the proposed redefinition of engineering education will not only facilitate understanding of fundamental science and engineering, but will give students an opportunity to apply that understanding to real-world design problems. In addition, students will be able to explore questions they encounter on their own using the physics-based and flexible simulation tools they have at their disposal.

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Purdue's Engineer of 2020 Seed Grant Program:
HUB-Enabled Curriculum Integration

Principal Investigators: Ashlie Martini, Ph.D
Co-Principal Investigators: Juan Diego Velasquez, Ph.D; Charles Krousgrill, Ph.D

Objective

We propose to integrate cyber-based simulation tools with electronic textbook material for the enhancement of student understanding within undergraduate gateway engineering courses. Using the HUB architecture, we now have the ability to make online tools available whereby students can quickly and easily run simulations of real physical phenomena without needing to manipulate the complex underlying software or having access to the computational resources on which the simulations are run. The new methods will be introduced into an existing Spring 2012 dynamics course (ME 274) as a pilot program. Educational outcomes will be assessed and, pending positive results, the methods will be introduced on a larger scale, initially to dynamics courses in other schools (Civil and AAE), but with the vision of implementing HUB-enabled, integrated curriculums throughout the Purdue undergraduate and graduate engineering experience.

The goal of this proposed project is: **To enhance the problem-solving and adaptability skills of early engineering students by integrating a suite of HUB-integrated curriculum tools into fundamental engineering courses.** We will achieve this goal by fulfilling three objectives: (i) Develop an interactive website, called STEM-HUB, to consolidate dynamics simulation software opportunities for student in-class and out-of-class use; (ii) Enhance learning outcomes with a custom electronic textbook designed to optimize the learning opportunities of the proposed HUB site; and (iii) Assess the learning gains of the HUB-enabled, integrated curriculum. To enable our students to meet the demands of an engineer in the Year 2020, we need to prepare them to operate in a computationally-based design environment similar to that found in industry. This necessarily means introducing simulation tools into our undergraduate curriculum and reinforcing this learning opportunity with integrated courseware.

Significance

The vision of this proposed project is directly aligned with the College of Engineering's strategic plan, which identifies one key strategy to be developing a web of resources and connections by "creating learning HUBs that define and launch a broader cyber-enabled education strategy." (Strategic Plan, 2009)

We propose the use of simulation tools in gateway courses to enable the students to create and manipulate the complex systems in an open and collaborative HUB environment. This approach will allow engineering faculty to address some of the challenges in complex reasoning and critical thinking that college students are facing in the first two years of their education (Arum & Roksa, 2011). Recent research has shown that highly interactive simulations result in higher comprehension scores and learning efficiencies especially for students with significant prior knowledge (Park et. al., 2009). Furthermore, several researchers have shown that the use of computer simulations is an effective strategy when teaching and learning complex tasks and phenomena that are not easily observable in real space (e.g., Lee, Plass, Homer, 2006; Rieber, Tzen and Tribble, 2004). One recent example of the effectiveness of simulation manipulation in enhancing student learning is presented in the work by Wong, Connely and Hartel (2010). In this study, food engineering processing students developed simulation tools for food science students; the study's outcomes report the simulation tool increased the food science student's correct responses by a minimum of 15% and up to 69%.

The proposed project will primarily enable the Knowledge Areas pillar within the Purdue Engineer 2020 framework. Specifically, the proposed redefinition of engineering education will not only facilitate understanding of fundamental science and engineering, but will give students

an opportunity to apply that understanding to real-world design problems. In addition, students will be able to explore questions they encounter on their own using the physics-based and flexible simulation tools they have at their disposal.

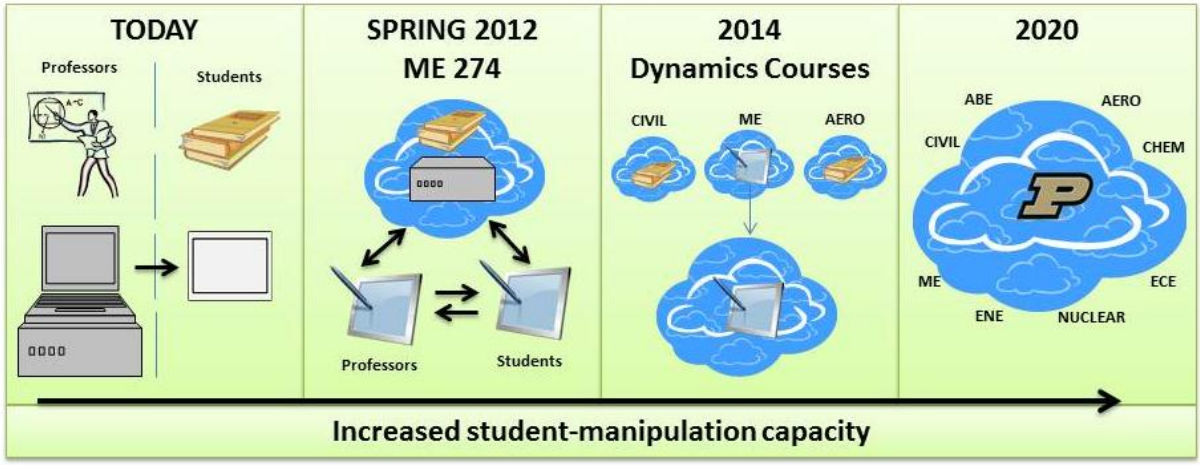

Figure 1: The proposed project will remove the existing boundaries between students, professors and their curriculum materials. Through this seed grant, students studying dynamics in ME 274 in Spring 2012 will benefit from a HUB-enabled integrated curriculum that erases such boundaries. By 2014, with the support of an anticipated TUES grant from NSF, we envision expanding the HUB-enabled integrated curriculum to all engineering schools teaching dynamics. By 2020, the Purdue School of Engineering may achieve its strategic vision of "creating a 'web' of resources and connections."

Implementation and Evaluation Plan

Our project's goal is to enhance the problem-solving and adaptability skills of early engineering students by integrating a suite of HUB-integrated curriculum tools into fundamental engineering courses. We will achieve this goal by fulfilling the following objectives.

Objective 1: Develop STEM-HUB to consolidate dynamics simulation software opportunities for student in-class and out-of-class use. (Objective Leader: Ashlie Martini, Ph.D) - The proposed curricular enhancements will be based on the capabilities of HUBzero, which is a platform for creating dynamic and interactive websites developed at Purdue. HUBzero's most significant distinguishing feature, and the one that we will take advantage of in the proposed project, is its ability to deliver interactive, graphical simulation tools through an ordinary web browser. The HUBzero infrastructure includes tool execution and delivery mechanisms so that any tool with a graphical user interface can be installed on the HUB and deployed within a few hours. For legacy tools and other codes without a graphical interface, an interface can be quickly created by using HUBzero's associated Rappture toolkit. Rappture is a toolkit supporting Rapid APPlication infrastructure that enables quick and easy development of powerful web applications. Deploying a tool using Rappture generally requires only defining the inputs and outputs and the desired graphical interface, and the toolkit handles the rest.

Through this proposed seed project, we will secure 100 floating licenses for the computer-animated simulation software, *Working Model*, and implement it as a HUB-based tool. Working Model will enable ME 274 students to directly manipulate dynamic simulations online, either in-class or out-of-class. Its capacity includes automatically simulating interactions among complex shapes with collision detection and response, such as the rolling and slipping of wheels; the tool also will enable students to view their simulations in various representations, such as the impact between two vehicles as an animation with vectors, line graphs, bar graphs, and meters. The software has been selected for multiple awards, including *Design New's* "Product of the Year" and *Machine Design's* "Editors' Choice" Award.

One of the first tasks of the proposed project will be to create a separate presence within an existing HUB, called Global-HUB. Global-HUB is dedicated to catalyzing innovative research

and collaboration tools, as well as curricular and co-curricular educational activities, to strengthen the field of global engineering. Global-HUB is an ideal partner for this seed project for several reasons. First, this shared approach is aligned with the Global-HUB team's commitment to continually increase a broad range of students' awareness of the global opportunities available. Secondly, our team felt increasing student's awareness of international engineering opportunities advances our goal of strengthening the students' Engineer 2020 abilities, such as: (i) working effectively in the global engineering profession; and (ii) work effectively in diverse and multicultural environments. Finally, as a seed project, this shared approach enables our team to implement this project in a cost-effective and efficient manner.

We will begin implementation by creating a user Group on the Global-HUB with access that is, initially, restricted to those on the development team and then expanded to the participating students. As with all HUB groups, the STEM-HUB group will have a wiki, a pool for resources, and a discussion board for talking. We anticipate implementing the technical aspects of this project by defining a small number of representative dynamical systems such as four-bar mechanisms. The tool will then enable students to vary inputs including force, speed, mass, and other constraints. These inputs will be fed into Working Model via the HUB execution and delivery features. Simulation output can then be manipulated on the HUB by students via pre-designed plots and animations, or data can be downloaded for further processing.

Objective 2: Enhance learning outcomes with a custom textbook designed to optimize the learning opportunities of the proposed HUB site. (Objective Leader: Charles Krousgrill, Ph.D) - During the past three years, the Mechanics Area of the School of Mechanical Engineering has participated in the NSF-sponsored HigherEd 2.0 research program for the instruction of undergraduate mechanics courses. This work has been focused on our sophomore-level dynamics course (ME 274). Three primary outcomes of this work have been:

- The development of integrated textbook and lecture note taking material - The textbook is comprised of theoretical derivations, conceptual material discussion and topical examples. The material is formatted in such a way that students add to the textbook during lecture with notes from lecture discussion and in-class example solutions. New lecture examples are incorporated into the textbook each semester, keeping the material fresh and up to date.
- The production of learning videos - Learning videos recorded by course instructors using pen tablet computers provide step-by-step example solutions and in-depth case studies of relevant course topics. Solution videos are typically integrated with animations produced from dynamic simulations. As of the Fall 2010 semester, over 500 solution videos have been produced for the course.
- The creation of social networks for learning collaborations - Course blogs have been created for student-lead discussion threads that allow for collaborations among students in learning course material and development of problem solving skills. In addition, student-generated learning videos have been produced in the course and delivered to course participants through the course blog. Recently, the course blog has also been used as the central tool for the co-offering of a single sophomore-level mechanics course to students at both Purdue and the University of Virginia. During a recent semester with an enrollment of 300 students in ME 274, over 1500 student blog posts were made with nearly 150,000 blog page hits by students.

This model of textbook/lecture notes, solution videos and course blog has been extended to a second course (ME 375: System Dynamics and Modeling). During the Spring 2011 semester, this course serves over 220 students in residence on the West Lafayette campus as well as 27 students at three international locations (China, Singapore and Spain). In summary, the work in HigherEd 2.0 has shown that these learning components can be combined together into a single package to be used by students taking Purdue courses on the West Lafayette campus and at other locations around the world. Such a program allows for the management of instructional resources

for improving the quality of instruction, for reaching an expanded base of students and allowing for geographically-separated members of teaching teams.

Although the HigherEd 2.0 program has been viewed as a success by both students and instructors in enhancing the learning environment, it still requires two separate components: the textbook/lecture notes and the laptop. Furthermore, the program has not yet been able to effectively integrate simulation tools with instruction. With the proposed HUB-enabled integrated curriculum, we propose to fully integrate all course material into a single component. The textbook/lecture notes material will be delivered electronically to students. Solution videos, animations and real-time simulations will be directly integrated within the electronic textbook. In this way, the student learning is enhanced by Mayer's spatial contiguity principle (Moreno & Mayer, 1999) in which textual and multi-media material are presented in close physical proximity. The student's laptop and tablet devices will allow them to add typed / handwritten notes during lecture, provide input to HUB-based simulations and communicate with instructors and other students through integrated course blogs. In addition, student-generated content can be uploaded to the HUB for viewing by instructors and students. The key tasks for Objective 2 of this project include the following:

- Restructure the presentation of the current textbook for optimal integration with media material - The current ME 274 textbook developed under HigherEd 2.0 was written primarily for static display and viewing by the students. Through this proposal, the presentation of the textbook will be re-structured for integration with media material such as existing problem solution videos and preset animations, with student-manipulated simulations served from the STEM-HUB and with student-to-student/student-to-instructor communication. This restructuring will be guided by spatial contiguity principles allowing the students to remain at a single location and facilitating the interconnection among all types of learning materials.
- Increase the number of design-based examples in textbook. Currently, the custom ME 274 textbook contains an extensive number of lecture examples that focus on problem-solving techniques (quantitative solution focus) and a limited number of conceptually-focused problems (qualitative solution focus). The inclusion of the proposed simulations within the textbook demands that a third type of problem is needed - a type of problem requiring extensive numeric calculations for which enhanced qualitative assessment of solution results are asked. In this project, considerable effort will be focused on the development of meaningful design-related problems of this type.
- Develop simulations to reinforce the qualitative assessment problems - Graduate teaching assistants will work alongside the principal investigators in the development of *Working Model* simulations for the conceptually-focused/qualitative-assessment type of problems described above. Focus will be given to the production of simulations that are readily grasped by the students and have user interfaces that facilitate ease of use by the students in the manipulation of the simulation inputs. Discussions connecting the simulation results to the qualitative nature of the response will be integrated into the revised textbook.

Objective 3: Assess educational value of HUB-enabled, integrated curriculum (Objective Leader: Juan Diego Velasquez, Ph.D) - In spring 2012, it is anticipated that there will be three sections of ME 274, with approximately 100 students in each class. For this project, we will employ the integrated-learning model in one class and have the remaining two classes as control groups. In order to measure the educational value of incorporating the HUB-enabled simulation tool into the curriculum for ME 274 a series of evaluation and assessment instruments will be used:

a. A technology driven pre and post survey to measure the students' affinity towards working and learning via HUB-enabled simulations.
b. A dynamics content driven pre and post survey to measure learning gains by the students related to the specific concepts that the simulations address. These instruments will be developed for all assignments that will employ the simulations

c. A dynamics content driven pre and post FINAL survey to measure learning gains throughout the semester by the students related to the learning outcomes for the course and connected to the project's goals.
d. A learning styles measure inventory (e.g., Felder's, Gregorc's) to determine the distribution of learning styles in the class and determine the class disposition towards learning with technology.
e. A series of focus groups to survey the students about their perceptions and reactions to the tools and be able to collect expand on the answers provided in the pre and post instruments.

Dissemination Plan and Future Work

The dissemination of results will be targeted at the Purdue University community at first in an effort to recruit one or two more professors that teach classes that will benefit from the development of HUB-enabled simulation tools to explain and further solidify challenging learning concepts among students. To promote the work within the academic community at Purdue we will participate in already existing conferences by units such as ITaP, the College of Education, Discovery Park, and others. Once the work has advanced beyond the one-semester, one-course model we will promote the program and model in the Annual ASEE conference and the Frontiers in Education conference.

The team's future plans are to submit a proposal to NSF's Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics (TUES), due late Spring 2011. In this proposal, we will seek funding to expand the HUB-enabled integrated curriculum to Dynamics courses taught in other schools of engineering, such as the Schools of Civil Engineering as well as Aeronautics and Astronautics. In addition, we anticipate examining whether the use of PC tablets by all students will increase the effectiveness of this integrated approach. Through these two methods, we will seek to replicate the program as well as maximize its impact.

Table 1: Timeline

	Sum. '11	Fall '11	Spr '12	Sum '11
Objective 1: Develop HUB to consolidate simulation software opportunities for student in-class and out-of-class use (Martini)				
Objective 2: Enhance learning outcomes with textbook and instructor's manual designed to optimize the learning opportunities of the proposed HUB site. (Krousgrill)				
Objective 3: Assess educational value of HUB-enabled, integrated curriculum (Velasquez)				
Project Dissemination (Martini)				

Potential Impact

Through the insights gained through this proposed project, the Purdue College of Engineering will be well-positioned to begin fully leveraging the educational power of its own HUB technology in the classroom. This is a critical step toward aligning our educational preparation of future engineers with anticipated demands of an engineer in the year 2020. The Knowledge Area of the Engineer 2020 emphasizes the importance of students learning "open-ended design and problem-solving skills" and the "integration of analytical, problem-solving and design skills." Purdue will also be at the forefront of employing online resources to erase the current boundaries between professors and students that minimize interaction. By creating a HUB-enabled integrated curriculum, students will no longer have to synthesize information from multiple disparate sources (ie, textbook, websites, class handouts) but instead benefit from a seamless curriculum in which all of these informational sources are fully integrated into one contiguous learning experience.

C. Personnel Requirements
Please indicate the portion of FTE that each faculty member will dedicate to the project

Faculty member	Summer 2011	Fall 2011	Spring 2012
Ashlie Martini, PhD	10%	5%	5%
Charles Krousgrill, Ph.D	10%	5%	5%
Juan Diego Velasquez, Ph.D	10%	5%	5%
Graduate Student	25%	25%	25%
Graduate Student	25%	25%	25%

D. Budget
The budget worksheet is provided to assist you in developing your budget. You may fill this out and paste it directly into your proposal.

Faculty/Staff Member Funding *Please indicate the funding (dollars and time) you are requesting for the grant for this project)*			
	Grant funds requested		
Faculty/Staff Name:	% Time	Fringe Benefits	$$
Juan Diego Velasquez, Ph.D	5%	$600	$4,000
Subtotal Faculty/Staff Funding		$600	$4,000

Graduate Students				
	Grant funds requested			
Type of position	% Time	Insurance + Fee Remit	Fringe Benefits	$$
Graduate Student	25%	$4,750	$65	$12,500
Graduate Student	25%	$4,750	$65	$12,500
Subtotal Grad Student Personnel		$ 9,500	$ 130	$25,000

Undergraduate Student Funding *Please indicate the student resources (funding and time) you are requesting from the grant for this project.*			
	Grant funds requested		
Type of position	Hrs/week	Fringe Benefits	$$

Subtotal Undergrad Student Personnel			

Equipment $ Software Funding *Please list all specialized equipment and software required for the project. (Do not include standard computer equipment and commonly-available software, e.g. Microsoft Office, Microsoft Windows). Mark whether any of the equipment or software is provided by the department. (Note that only 10% of the funds can be used to purchase equipment and it needs to be dedicated to the goals of the project.*	
Name of Equipment	Funds Requested
N/A	
Subtotal Equipment	$0.00
Name of Software	
100 perpetual, floating licenses for Working Model software	10,000
Subtotal Software	$10,000
Subtotal miscellaneous	$0.00

Other expenses	
Minor supplies	$1,000
Subtotal other expenses	

Grand Total*	$50,230

*In order to stay within the budget of $40,000 the team requests general funds as the seed grant funding in order to waive the fringes and fee remits equal to $10,230 which will put the budget at $40,000.

E. Budget Justification

Staff Time

- Juan Diego Velasquez, Ph.D is Assistant Director for TA and Curricular Development at Purdue's Center for Instructional Excellence (CIE). He will dedicate 5% of his time, totaling $4,000, to assess the educational impact of the proposed HUB-enabled integrated curriculum.
- Two graduate students will be hired to dedicate 25% of their time, totaling $12,500 each, to assist the PI and Co-PIs with the implementation and the assessment of the project. This effort will include the implementation of the STEM-HUB, the development of qualitative problems for the text book that integrate with the STEM-HUB and assessment of whether this approach resulted in improved student learning.
- Drs. Martini and Krousgrill will incorporate their effort as part of their normal teaching and college service responsibilities.

Software Expenses

The team will pay a total of $10,000 to purchase the software Working Model as well as 100 perpetual floating licenses for student use.

F. References

Arum, R., Roksa, J. (2011). Academically Adrift: Limited Learning on College Campuses, University of Chicago Press. 256 pages.

Lee, H., Plass, J. L., & Homer, B. (2006). Optimizing cognitive load for learning from computer science simulations. Journal of Educational Psychology, 98(4), 902–913.

Moreno, R., & Mayer, R. (1999). "Cognitive principles of multimedia learning: The role of modality and contiguity". Journal of Educational Psychology 91: 358–368.

Rieber, L. P., Tzeng, S., & Tribble, K. (2004). Discovery learning, representation, and explanation within a computer-basedsimulation: Finding the right mix. Learning and Instruction, 14(3), 307–323.

Strategic Plan for the Purdue College of Engineering, 2009-2014
https://engineering.purdue.edu/Engr/AboutUs/StrategicPlan/2009-2014

Wong, S. Y., Connelly, R. K., Hartel, R. W. (2010) Enhancing Student Learning in Food Engineering Using Computational Fluid Dynamics Simulations, Journal of Food Science Education, 9, 90-97.

PURDUE UNIVERSITY

PROFESSIONAL PRACTICE PROGRAMS

January 24, 2011

Dr. Ashlie Martini
School of Mechanical Engineering
Purdue University
West Lafayette, Indiana 47907

Subject: Your Seed Grant Proposal to the Engineer 2020 competition

Dear Ashlie,

As the co-Principal Investigator of the NSF-funded Global-HUB, I am very pleased to express my strong support of your seed grant proposal to the Engineer 2020 competition. I am also looking forward to having STEM-HUB work within the Global-HUB architecture.

Global-HUB is dedicated to strengthening the field of global engineering by catalyzing innovative research and collaboration tools, as well as curricular and co-curricular educational activities. By integrating ME 274's textbook and simulation tools onto the Global-HUB, more than 100 students in one semester will benefit from improved understanding of dynamics as well as increased awareness of the unique global engineering opportunities available through Purdue University. This is an excellent approach to instilling the target attributes of Purdue's Engineer of 2020 and we will be proud to play a role in this important effort.

Please contact me if you have any further questions or need additional information.
Yours sincerely,

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Professor of Mechanical Engineering
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E-mail: groll@purdue.edu

Ashlie Martini

Assistant Professor, Mechanical Engineering, Purdue University

A. Professional Preparation

Northwestern University	Mechanical Engineering	B.S. 1998
Northwestern University	Mechanical Engineering	Ph.D. 2007

B. Appointments

8/08 – present Assistant Professor, Mechanical Engineering, Purdue University
8/07 – 7/08 Visiting Assistant Professor, Mechanical Engineering, Purdue

C. Publications

Closely Related to Current Project

Perez D, Dong Y, Martini A and Voter AF, "On the Rate Theory Description of Atomic Stick-Slip Friction," *Physical Review B* 81 (2010) 245415.

Martini A and Vadakkepatt A, "Compressibility of Thin Film Lubricants Characterized Using Atomistic Simulation," *Tribology Letters* 38 (2010) 33-38.

Martini A, Dong Y, Perez D and Voter AF, "Low Speed Atomistic Simulation of Stick-Slip Friction using Parallel Replica Dynamics," *Tribology Letters* 36 (2009) 63-68.

Martini A, Hsu H-Y, Patankar NA, and Lichter S, "Slip at High Shear Rates", *Physical Review Letters* 100 (2008) 206001.

Lichter S, Martini A, Snurr RQ and Wang Q, "Liquid Slip as a Rate Process," *Physical Review Letters* 98 (2007) 226001.

Other Significant Publications

Greco A, Martini A, Liu Y, Lin C and Wang Q, "Rolling Contact Fatigue Performance of Vibro-Mechanical Textured Surfaces," *Tribology Transactions* 53 (2010) 610 - 620.

Martini A and Bair S, "The Role of Fragility in EHL Entrapment," *Tribology International* 43 (2010) 277-282.

Martini A, Roxin A, Wang Q, Snurr RQ, and Lichter S, "Molecular mechanisms of liquid slip", *Journal of Fluid Mechanics* 600 (2008) 257–269.

Martini A, Zhu D and Wang Q, "Friction Reduction in Mixed Lubrication", *Tribology Letters* 28 (2007) 109-222.

Zhu D, Martini A, Wang W, Hu YH, Lisowski B and Wang Q, "Simulation of Sliding Wear in Mixed Lubrication," *ASME Journal of Tribology* 129 (2007) 544-552.

D. Synergistic Activities

Profession Society and University

Chairperson, STLE Young Tribologists Committee, 2009-present

Vice-Chair, STLE Nanotechnology Technical Committee, 2010-present

Conference Planning Committee, STLE/ASME International Joint Tribology Conference, 2008-present

Active contribution of interactive educational tools to the publically available site nanoHUB.org, Forced Protein Unfolding (http://nanohub.org/resources/6804) and Atomic Stick-Slip Toolkit (http://nanohub.org/resources/7771)

Nanotribology Track Chair, STLE/ASME International Joint Tribology Conference, 2008-2009

Invited Participant, Atomic-scale Friction Research and Education Synergy Hub (AFRESH) project kick-off workshop, 2007.
Chairperson, Northwestern University NSF-IGERT Annual Symposium on Virtual Tribology, 2006.

Cyber-based Outreach

Forced Protein Unfolding (http://nanohub.org/resources/6804): Freely available online simulation tool for molecular dynamics simulations of protein unfolding
Atomic Stick-Slip Toolkit (http://nanohub.org/resources/7771): Freely available online simulation tool that enables molecular dynamics simulation of atomic stick-slip friction
Protein Contact Maps (http://nanohub.org/resources/9924): Freely available online tool for generating distance and contact maps for any entry in the Protein Data Bank
Short Course on Molecular Dynamics Simulation (http://nanohub.org/resources/7570): Ten lecture series that provides an introduction to molecular dynamics simulation as a research tool
Addressing Molecular Dynamics Time-scale Issues to Study Atomic-scale Friction (http://nanohub.org/resources/9856): Audio and video presentation

E. Collaborators and Other Affiliations

Collaborators and Co-Editors

Los Alamos National Laboratory: Dr. AF Voter, Dr. D Perez
Northwestern University: Prof. S Lichter
Purdue University: Prof. A Raman, Prof. R Reifenberger, Prof. M Ivantysynova, Prof. J Lumkes, Prof. F Sadegi, Prof. P Zavattieri
United States Forrest Service: Dr. R Moon
University of Pennsylvania: Prof. RW Carpick

Graduate and Post Doctoral Advisors

Professor Q. Jane Wang, Northwestern University, Department of Mechanical Engineering

Thesis Advisor and Postgraduate-Scholar Sponsor

Current:

Brandt, Daniel – MS student, Mechanical Engineering
Dong, Yalin – PhD student, Mechanical Engineering
Garcia, Jose – PhD student, Agriculture and Biological Engineering
Rafferty, Benjamin – MS student, Electrical and Computer Engineering
Udupa, Anirudh – MD student, Mechanical Engineering
Vadakkepatt, Ajay – PhD student, Mechanical Engineering
Wu, Jianguo – MS student, Mechanical Engineering
Wu, Xiawa – PhD student, Mechanical Engineering
Yang, Lingqi – PhD student, Mechanical Engineering

Previous:

Gylfadóttir, Hildur – MS, Mechanical Engineering, 7/2010
Gao, Zhenjia – MS, Mechanical Engineering, 8/2009

CHARLES M. KROUSGRILL
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a. Professional Preparation

Purdue University	BSME, Mechanical Engineering	1975
California Inst. of Technology	MS, Applied Mechanics	1976
California Inst. of Technology	PhD, Applied Mechanics	1981

b. Appointments

Purdue University	Interim Director of Office for Professional Practice	2010-present
Purdue University	Academic Director, Engineering Professional Education	2004-2009
Purdue University	Professor of Mechanical Engineering	1997 - present
Purdue University	Associate Professor	1987 - 1997
Purdue University	Assistant Professor	1980 - 1987
Kinemetrics, Inc.	Research Engineer, Pasadena, CA	1978 - 1979

c. Publications

(i) Five most closely related publications

1. Huang, J., Krousgrill, C.M. and Bajaj, A.K., "An efficient approach to estimate critical value of friction coefficient and sensitivity analysis for brake squeal", *International Journal of Vehicle Design*, Vol. 51, pp. 21-38, 2009.
2. Conley, W.G., Raman, A. and Krousgrill, C.M., "Nonlinear and nonplanar dynamics of suspended nanotube and nanowire resonators", *Nano Letters*, Vol. 8, pp. 1590-1595, 2008.
3. Harris D.A. and Krousgrill C.M., "Distance education: New technologies and new directions", *Proceedings of the IEEE*, Vol. 96, pp. 917-930, 2008.
4. Conley, W.G., Krousgrill C.M. and Raman A, "Stick-slip motions in the friction force microscope: Effects of tip compliance", *Tribology Letters*, Vol. 29, pp, 23-32, 2008.
5. Kang, J., Krousgrill, C.M., and Sadeghi, F. ,"Comprehensive Stability Analysis of Disc Brake Vibrations including Gyroscopic, Negative Friction Slope and Mode-Coupling Mechanisms" *Journal of Sound and Vibration*, Vol. 324, pp. 387-407, 2008.

(ii) Five other significant publications

1. Kang, J., Krousgrill, C.M. and Sadeghi, F., "Analytical Formulation of Mode-Coupling Instability in Disc-Pad Coupled System" *International Journal of Mechanical Science*, Vol. pp. 52-63. 2008.
2. Huang, J., Krousgrill, C.M. and Bajaj, A.K., "An Efficient Approach to Estimate Critical Value of Friction Coefficient in Brake Squeal Analysis", *Journal of Applied Mechanics*, Vol. 74, pp. 534-541, 2007.
3. VanderLugt, D.N., Krousgrill, C.M. and Sadeghi, F., "Experimental Observations of Coupled-Mode Instability in Disc Brake Systems Leading to Squeal Vibration", *International Journal of Vehicle Noise and Vibration*, pp. 266 – 280 Vol. 2, No. 3, 2006.
4. Widdle, R.D., Krousgrill, C.M. and Sudhoff, S.D., "An induction motor model for high-frequency torsional vibration analysis", *Journal of Sound and Vibration*, Vol. 290, pp. 865-881, 2006.
5. Duncan, M.R., Wassgren, C.R. and Krousgrill, C.M., "The damping performance of a single particle impact damper", *Journal of Sound and Vibration*, Vol. 286, pp. 123-144, 2005.

d. Synergistic Activities

- Development of an international distance undergraduate course in dynamics and modeling with delivery to China, Singapore, Mexico and Spain.
- Development of technology tools for the instruction of undergraduate mechanics courses (previous NSF grant of HigherEd 2.0). Produced over 500 solution videos as one component of this project.
- Development and offering of an undergraduate mechanics course co-taught at University of Virginia and Purdue University (with E.J. Berger).
- Director of cooperative education program in the College of Engineering.
- Director of distance graduate education program for College of Engineering.
- Teaching of mechanics and mechanical design courses at Karlsruhe University (Germany).
- Recipient of eight teaching awards from School of Mechanical Engineering, three teaching awards from College of Engineering and one university-wide teaching award.
- Founding Fellow of Teaching Academy (Purdue).
- Member of the Great Book of Teachers (Purdue).
- Outstanding Boilermaker Award for contributions to teaching (Purdue).

e. Collaborators & Other Affiliations
(i) Collaborators

A.K. Bajaj - Purdue
E.J. Berger – Univ. Virginia
D.A. Harris - Purdue
J. Huang – Tsinghua (China)
M.A. Franchek – Univ. Houston
W.D. Iwan - Caltech
J. Kang – Konju Univ. (Korea)
D. Quinn – Univ. Akron
A. Raman - Purdue
J.F. Rhoads - Purdue
F. Sadeghi - Purdue
W. Soedel - Purdue
M.M. Stanisic – Notre Dame
D.S. Stutts – Missouri S&T
S. D. Sudhoff - Purdue
C.R. Wassgren - Purdue

(ii) Graduate and Post Doctoral Advisors
MS Advisor: W.D. Iwan (Caltech)
PhD Advisor: W.D. Iwan (Caltech)

(iii) Thesis Advisor and Postgraduate-Scholar Sponsor
Thesis Advisor
MS: D. Allaei (1983), M. Beaty (1986), J. Restuccio (1988), D.A. Nickel (1992), M.M. Surella (1993), J.A. Thompson (1994), B.K. Servis (1994), R. Becker (1996), C.O. Yttri (1998), S. Ramamurthy (1999), V.K. Meel (2000), H.V. Chowdhary (2001), E. Chang (2001), A. Kumar (2004), C. Conklin (2004), D.N. Vanderlugt (2004), M.R. Duncan (2004)

PhD: D.A. Streit (1986), Y.M. Huang (1987), R.I. Zadoks (1988), K.B. Blair (1992), S.I. Chang (1993), E.J. Berger (1996), D.A. Nickel (1999), B.K. Servis (2000), C.L. Davis (2002), R. Mennem (2004), J. Huang (2005), J. Kang (2008), W.C. Conley (2009)

Postgraduate Advisor: J. Kang (2009)

Biographical Sketch – Juan D. Velasquez

Professional Preparation

Purdue University, West Lafayette, IN	Industrial Engineering	B.Sc./1998
Purdue University, West Lafayette, IN	Industrial Engineering	M.Sc./2003
Purdue University, West Lafayette, IN	Industrial Engineering	Ph.D./2009

Appointments

Assistant Director TA and curricular development. Center for Instructional Excellence (CIE), Purdue University, August 2008 to present. At CIE since June 2004.

Senior Researcher. Production, Robotics and Integration Software for Manufacturing and Management, PRISM Center, August 2006 to present.

Publications

Most closely related:

1. Plikuhn, M., Helgesen, M., Velásquez, J. D. (2010). One Small Step for Teaching, One Giant Leap for Scholarship: The Importance of Recognition at a Research University, Transformative Dialogues: Teaching and Learning Journal, 4, 1-8.
2. Velásquez, J. D., Yoon, S. W., and Nof, S. Y. (2009). Computer-based Collaborative Training for Transportation Security and Emergency Response, Computers in Industry.
3. Velásquez, J. D., Nof, S. Y. (2009). Collaborative e-Work, e-Business, and e-Service, Chapter 88 in *Springer Handbook of Automation*, S.Y. Nof, Ed. New York: Springer.
4. Velásquez, J. D., Verleger, M. (2007). Training of Teaching Assistants on Technology Driven Lesson Development, Proceedings of the 114th American Society for Engineering Education Conference.
5. Verleger, M., Velásquez, J. D. (2007). An Engineering Teaching Assistant Orientation Program: Guidelines, Reactions, and Lessons Learned form a One Day Intensive Training program, Frontiers in Education 2007 Conference.

Others

6. Velásquez, J. D., Nof, S. Y. (2008). A Best-Matching Protocol for Collaborative e-Work and e-Manufacturing, *International Journal of Computer Integrated Manufacturing*, 21(8), 943-956.
7. Velásquez, J. D., Lara, M. A., Nof, S. Y. (2008). Systematic Resolution of Conflict Situations in Collaborative Facility Design, *International Journal of Production Economics*, 116, 139-153.

8. Velásquez, J. D., Chen, X., Yoon, S. W., Ko, H. S. (2009). Automation statistics, Chapter 95 in *Springer Handbook of Automation*, S.Y. Nof, Ed. New York: Springer.

9. Yoon, S. W., Velásquez, J. D., Partridge, B. K., Nof, S. Y. (2008). Transportation Security Decision Support System for Emergency Response: A Training Prototype, *Decision Support Systems*, 46, 139-148.
10. Uzsoy, R., Velásquez, J., (2008). Heuristics for Minimizing Maximum Lateness on a Single Machine with Family Dependent Set-up Times, *Computers in Operations Research,* 35(6), 2018-2033.
11. Velásquez, J. D., Nof, S. Y., Partridge, B., Poturalski, J. (2005). Transportation Security Training by INDOT, *TR News*, 26-27.

Collaborators & other affiliations

Collaborators and Co-Editors:

H. S. Ko (Purdue University), X. W. Chen (Southern Illinois University), S. W. Yoon (Binghamton University), W. Jeong (Korea Rail Research Institute), M. Lara (University of Southern Indiana), M. Plikuhn (University of Evansville).

Graduate Advisors and Postdoctoral Sponsors

S. Y. Nof (Purdue University, West Lafayette, USA), R. Uzsoy (North Carolina State University, North Carolina, USA)

Current and Pending Support

Dr. Ashlie Martini, PI

Current

Title: Nanoscale Tribology of Taste: Relating Texture to Oral Sensory Perception for Design of Functional Foods
Sponsor: United States Department of Agriculture
Award #: 2009-35603-05002
Project Period: 1/1/2009 - 12/31/2010 (no-cost extension through 6/1/2011)
Total Amount: $96,697
Time Commitment: 1 week in 2009, 2 weeks in 2010

Title: BRIGE: Building the Foundation for Nanoscale Interface Design
Award #: EEC-0821875
Sponsor: National Science Foundation
Project Period: 8/1/2008 - 7/31/2010 (no-cost extension through 7/31/2011)
Total Amount: $174,937
Time Commitment: 1 month in 2009 and 2010

Title: Collaborative Research: Dissipation in Atomic-Scale Friction - A Coordinated Experimental and Modeling Study
Sponsor: National Science Foundation
Award #: CMMI-0758604
Project Period: 6/15/2008 - 5/31/2011
Total Amount: $126,929
Time Commitment: 1 month in 2009 and 2010

Title: Predicting Static Friction in Line and Point Contacts to Improve Start-Up Efficiency in Hydraulic Motors
Sponsor: Center for Compact and Efficient Fluid Power
Project Period: 6/1/2010 – 5/31/2011
Amount of Support: $111,250

Pending

Title: Collaborative Research: Determining the Physical Mechanisms of Atomic-Scale Friction by Closing the Gap between Experiments and Atomistic Simulations
Sponsor: National Science Foundation
Project Period: 4/1/2011 – 3/31/14
Proposed Budget: $214,842
Time Commitment: 5% Annual

Title: Nanomechanics of Cellulose Nanocrystals
Sponsor: National Science Foundation
Project Period: 5/1/11 – 4/30/14
Total Amount: $467,141
Time Commitment: 5% Annual

Title: Mechanics of the hierarchical structure of crystalline cellulose
Sponsor: National Science Foundation

Project Period: 5/1/2011 – 4/30/2014
Proposed Budget: $330,602
Time Commitment: 1 summer month

Dr. Charles Krousgrill

Pending

Engineering Genome Project, National Science Foundation, 9/1/11-8/31/14

Dr. Juan Diego Velasquez

Current

Title: Service Learning and Graduate Education: The New Frontier
Sponsor: Indiana Campus Compact (ICC)
Award #: 00029392
Project Period: 8/18/2010-5/31/2011
Total Amount: $5,000
Time Commitment: 5 % FTE