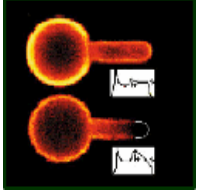




# University of Pennsylvania

## Graduate Program in Mechanical Engineering and Applied Mechanics

### Research Areas



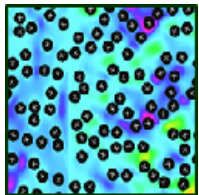
#### Biomechanics

P.S. Ayyaswamy, J. Bassani, G. Biros, D. Discher, D. Eckmann, D. Elliott, I. Shapiro, and L. Soslowsky  
Research spans from molecular level through tissue with major efforts in cell mechanics and biophysics, biomolecular simulation, gravity effects on cells and tissues, tendon and ligament injury, repair, and regeneration, and intervertebral disc function and degeneration.

#### Computational Mechanics

G.K. Ananthasuresh, P.S. Ayyaswamy, J. Bassani, H. Bau, G. Biros,  
P. Ponte Castañeda, H. Hu, V. Kumar, J. Lukes, N. Lior, H. Rubin, and V. Vitek

Research in, and application of novel computational methodologies in analysis, design and control. Examples include research in mesoscale and nanoscale materials science, molecular dynamics, plasticity and fracture, flows with dynamic interfaces and moving boundaries, multiphase flows and transport, electro- and magneto-hydrodynamics, wave propagation, microgravity, modeling and computation of biological networks in Scientific computation, and robotics and dynamical systems.



#### Fluid Mechanics

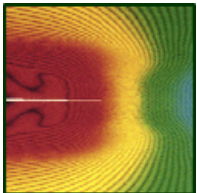
P.S. Ayyaswamy, H. Bau, G. Biros, I. Cohen, D. Eckmann, H. Hu, and N. Lior

Microfluidics and laboratory on a chip, multi-phase flows, problems of relevance to biology and medicine, micro-electronic manufacturing, complex fluids and materials processing, hydrodynamic instabilities and flow control, and computational fluid mechanics.

#### Mechanical Systems

G. Ananthasuresh, H. Bau, G. Biros, T. Cassel, V. Kumar, H. Rubin, C. Taylor, and K. Ulrich

Robotics, design optimization, microelectromechanical systems, mechatronics, compliant mechanisms, nonlinear control, vision-based control, hybrid systems, product design, customized rehabilitation devices, and assistive technology.



#### Mechanics of Materials

J. Bassani, D. Discher, P. Ponte Castañeda, D. Elliott, C. McMahon, L. Soslowsky, and V. Vitek

Crystal plasticity, effective properties of nonlinear composites and polycrystals, atomic/continuum property relations, localization studies, phase transitions, interfacial fracture, fatigue and high temperature fracture, soft materials, cell mechanics, anisotropy and viscoelasticity of soft composites.

#### Thermal Sciences and Energy Conversion

P.S. Ayyaswamy, H. Bau, S. Churchill, I. Cohen, H. Hu, J. Lukes, and N. Lior

Nano, micro, and macro heat transfer, molecular dynamics simulation, energy analysis and conversion, alternate energy sources, bio-heat transfer, combustion, water desalination and waste treatment, electronic packaging, and materials processing.



### Degree Programs

The M.S.E. degree requires successful completion of 10 course units. Optional Master's thesis research may count for up to 3 course units. Typically, M.S.E. students in good standing take up to five courses per semester.

The Ph.D. degree requires a minimum of 20 course (including research) units beyond the B.S. degree and a dissertation. The M.S.E. degree is not a prerequisite for the Ph.D. Various fellowships are available to U.S. and international students.

### Why Penn?

- The People: A distinguished and multidisciplinary faculty, within a stimulating academic environment.
- The Program: Cutting edge, interdisciplinary educational and research programs, with close ties to the School of Arts and Sciences, the School of Medicine, and Wharton Business School as well as centers of excellence: General Robotics Automation Sensing and Perception (GRASP) Lab, Laboratory for Research on the Structure of Matter (LRSM), Institute for Medicine and Engineering (IME), Nanotechnology Institute (NTI), and Center for Science and Engineering of Nanoscale Systems (SENS).
- The Place: Founded by Benjamin Franklin in 1740, Penn is a major research university and an established Ivy League institution. The university is located in an attractive 260 acre campus just a few blocks from center city Philadelphia.
- The Surroundings: Philadelphia is a thriving multicultural city with a small town atmosphere and convenient access to both New York and Washington, D.C.

### Primary Faculty

- G. K. Ananthasuresh**, Associate Professor and Graduate Group Chair. Compliant mechanisms, microelectromechanical systems (MEMS), design optimization, kinematics of mechanisms.
- Portonovo S. Ayyaswamy**, Asa Whitney Professor of Dynamical Engineering. Phase change heat and mass transfer processes, bioheat/mass transfer, arc-plasma heat transfer, and thermal aspects in MEMS.
- John L. Bassani**, Richard H. and S. L. Gabel Professor in Mechanical Engineering and Chair. Plastic deformation of crystals, atomic/continuum property relationships, interface mechanics, fracture mechanics, material stability at large strains, mechanics of living cells.
- Haim H. Bau**, Professor. Bifurcation and instability phenomena in and feedback control of flows; transport phenomena in micron and submicron size structures, meso- and microelectromechanical systems.
- George Biros**, Assistant Professor. Computational science and engineering, optimization algorithms, inverse problems, computational fluid mechanics, integral equations, fast multipole methods, parallel and scientific computing.
- Ira M. Cohen**, Professor. Basic problems in fluid mechanics and heat transfer as applied to microelectronic processing. Plasmas in combustion and manufacturing.
- Howard H. Hu**, Associate Professor. Modeling of complex flows with multiphase or polymeric fluids, computational fluid dynamics, hydrodynamic stability.
- Vijay Kumar**, Professor and Deputy Dean for Research. Robotics, dynamics of systems with frictional contacts, actively coordinated mobility systems, mechanism design and control.
- Noam Lior**, Professor. Heat transfer and fluid mechanics, thermodynamics and Second-Law analysis, energy conversion, solar energy, combustion, flash evaporation and water desalination, destruction of hazardous wastes by photocatalysis and supercritical oxidation, heat treatment.
- Jennifer R. Lukes**, William K. Gemmill Term Assistant Professor. Molecular dynamics simulation, molecular mechanical engineering, micro/nanoscale heat transfer.
- Pedro Ponte Castañeda**, Professor. Nonlinear composite and polycrystalline materials, fracture mechanics, microstructure evolution and localization in manufacturing processes, mechanics of polymers, nonlinear variational principles in mechanics.

### Affiliated Faculty

- Michael Carchidi**, Lecturer, Mechanical Engineering and Applied Mechanics. Engineering mathematics and systems modeling.
- Thomas A.V. Cassel**, Professor of Practice, Mechanical Engineering and Applied Mechanics. Engineering Entrepreneurship.
- Stuart Churchill**, Carl V. S. Patterson Professor Emeritus of Chemical Engineering. Combustion, incineration, crystal growth, rate processes and correlation, computerized analysis.
- Dennis E. Discher**, Associate Professor. Mechanics and structural assemblies of biomolecules, mechanochemistry of cells, mechanics and statistical mechanics of networks and complex fluids.
- David M. Eckmann**, Associate Professor of Anesthesia. Experimental and computational biofluid dynamics, interfacial fluid mechanics, molecular mechanics of cellular activation and biological adhesion to vascular tissue and biomimetic materials.
- Dawn M. Elliott**, Assistant Professor of Orthopaedic Surgery and Bioengineering. Orthopaedic biomechanics of the intervertebral disc; anisotropic, nonlinear, and viscoelastic biomechanics; models of disc degeneration; structure-function of the disc.
- Robert L. Jeffcoat**, Adjunct Professor, Mechanical Engineering and Applied Mechanics.
- Charles J. McMahon, Jr.**, Professor Emeritus of Material Science and Engineering. Mechanisms of intergranular embrittlement and fracture in high-strength structural materials, especially as related to environmental effects. Current interests are dynamic embrittlement in nickel and copper-based alloys and in steels.
- James P. Ostrowski**, Adjunct Professor of Mechanical Engineering and Applied Mechanics. Mechanics and control of nonlinear dynamical systems, microelectromechanical systems, motion planning for underactuated systems, visual servoing, and robotic locomotion.
- Harvey Rubin**, Professor of Infectious Diseases, School of Medicine. Modeling complex biological behavior using a hybrid systems approach that combines continuous and stochastic modalities, enzymology and genetics of dormancy in Mycobacterium tuberculosis, enzymology and cell biology of serine proteases and serine protease inhibitors.
- Irving M. Shapiro**, Professor of Orthopaedic Surgery, Jefferson Medical College. Cellular mechanism of bone and cartilage formation; effects of microgravity on bone; the structure and function of the intervertebral disc; orthopaedic implant design and tissue integration.
- Louis J. Soslowsky**, Associate Professor of Orthopaedic Surgery and Bioengineering and Director of Orthopaedic Research. Orthopedic biomechanics; structure-function studies of tendons and ligaments; models of tendon injury, repair, and healing; shoulder joint mechanics.
- Camillo J. Taylor**, Assistant Professor of Computer and Information Science. Reconstructing and re-rendering 3D scenes from 2D images and vision guided robotic systems.
- Karl T. Ulrich**, Associate Professor of Operations and Information Management (Wharton School). Product design, product development, technology and operations management, computer-aided design, manufacturing.
- Vaclav Vitek**, Professor of Materials Science and Engineering. Computer modeling of the structure and properties of grain boundaries, metal-metal and metal-ceramic interfaces, dislocations and other lattice defects.

### For More Information

For more information about research opportunities, degree requirements, and financial support, send us email at [banford@seas.upenn.edu](mailto:banford@seas.upenn.edu) or visit our Web site at <http://www.me.upenn.edu>

An on-line graduate application is available at <https://sentry.isc.upenn.edu/ga/owa/gapk0101.bf00>

See <http://www.me.upenn.edu/grad/waiver.html> for information about an application fee waiver.