ABOUT INTERPRO

Michigan Interdisciplinary and Professional Engineering (InterPro) develops and delivers programs and services that enable engineers, managers, and technical professionals to be more effective, productive, and competitive. InterPro extends and enhances the programs, capabilities, and relationships of the faculty and affiliates of the College of Engineering by offering graduate degree programs, distance learning, non-credit public short courses, professional certification programs, and conferences.

Graduate degree programs currently offered include:
- Automotive Engineering
- Energy Systems Engineering
- Engineering Sustainable Systems
- Financial Engineering
- Global Automotive and Manufacturing Engineering
- Integrated Microsystems
- Manufacturing Engineering
- Pharmaceutical Engineering

NEW PROGRAM

COMPLIANT DESIGN

Almost any product can be considered for a no-assembly design approach using compliant mechanisms.

Bring a real-life problem from your workplace to this hands-on class and develop a functional prototype using biologically-inspired design principles.

To learn more about InterPro programs, visit InterPro.engin.umich.edu, send an email to MEonline@umich.edu or call (734) 647-7200.

Register Online Today: InterPro.engin.umich.edu

The Regents of the University of Michigan
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Laurence B. Datch, Bingham Farms
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S. Martin Taylor, Grosse Pointe Farms
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The University of Michigan, as an equal opportunity/affirmative action employer, complies with all applicable federal and state laws regarding nondiscrimination and affirmative action, including Title IX of the Education Amendments of 1972 and Section 504 of the Rehabilitation Act of 1973. The University of Michigan is committed to a policy of nondiscrimination and equal opportunity for all persons regardless of race, sex, color, religion, creed, national origin or ancestry, age, marital status, sexual orientation, disability, or Vietnam-era veteran status in employment, educational programs and activities, and admissions. Inquiries or complaints may be addressed to the Senior Director for Institutional Equity and Title IX/Section 504 Coordinator, Office of Institutional Equity, 2072 Administration Services Building, Ann Arbor, Michigan 48109-1432, (734) 763-0235,TTY (734) 647-1388. For other University of Michigan information call (734) 764-1817. *Includes gender identity and gender expression
A product’s quality and cost are greatly impacted by the number of parts it contains. Several studies indicate that across a wide range of industries, assembly accounts for more than 40% of the labor cost and about 50% of the manufacturing cost.

ABOUT COMPLIANT DESIGN
A compliant mechanism is a flexible single piece that elastically deforms without joints to produce desired functionality such as force or motion transmission, motion guidance, or energy storage and release. Compliant mechanisms take the well-known Design for Assembly (DFA) methodology to its limit of a single part with no assembly. It allows precision engineering and precision design while often lowering cost. In addition to simpler construction, compliant structures have unique qualities that give them higher fatigue life and reliability. Virtually any product with multiple mechanical parts performing a motion function can be considered for a no-assembly design approach utilizing compliant mechanisms.

ADVANTAGES OF COMPLIANT DESIGN
- Minimizes or eliminates assembly requirements
- Eliminates joint friction, need for lubrication, or backlash
- Reduces part count
- Reduces weight by eliminating the need for restoring springs and bulky hinges
- Creation of motions not possible with conventional rigid devices
- Provides reliable and high-precision operation
- Introduces simple, cost-effective construction
- Scalable to micro-, meso-, or macro-sized
- Can be designed for desired stiffness and built from any highly resilient material including steel, aluminum, titanium, polymers, composites, polysilicon, etc.
- Easily couples with modern actuators such as piezoelectric, shape-memory alloy, electro-thermal, electrostatic, fluid pressure, and electromagnetic actuators

COMPLIANT DESIGN APPLICATIONS
- Shape morphing on demand
- Design for no assembly
- Active flow control
- Micro electro mechanical systems (MEMS)
- Advanced actuators
- Medical devices
- Custom mechanical systems

WHO SHOULD ATTEND
This course is intended for practicing design and product engineers, mid-level managers, and technology leaders who are involved in the design and development of electromechanical systems and interested in part count reduction and quality improvement. Ideally, they will have a bachelor’s degree in Mechanical Engineering or equivalent experience. There are no mathematic or software requirements.

FREQUENTLY ASKED QUESTIONS
- **Can someone who is not a design engineer attend?** No. This program is intended for engineers and managers who design, develop, or manage products with moving parts and are not familiar with the concepts of compliant design.
- **What is the program schedule?** The program is scheduled from 8:00 AM to 4:30 PM daily, with lab sessions on Day 1 and practical case studies on Day 2.
- **Is there a discount for companies sending multiple people?** Yes. Companies can receive a discount by sending a team of five or more.

PROGRAM AGENDA

**DAY 1 (AM)**
- Introduction and Benefits of Distributed Compliance
- Overview of Applications in MEMS, Aerospace, Automotive, Appliance, and Medical Instruments

**DAY 1 (PM)—LAB**
- Design Software: Hands-on design problem-solving (we will provide three different types of problems to choose from in case the attendee did not come prepared with a design problem of his/her own) including use of University proprietary software and water-jet laser cutting
- Your final design will be fabricated overnight by program staff

**DAY 2 (AM)**
- Material and Manufacturing Analysis Methods
- Precision Engineering

**DAY 2 (PM)**
- Practical Case Studies
- Device Testing
- Lessons Learned

APPLICATIONS
- Custom mechanical systems
- Medical devices
- Micro electro mechanical systems (MEMS)
- Advanced actuators
- Medical devices
- Custom mechanical systems

INSTRUCTORS

**SRIJTHAR KOTA, Ph.D.** Professor of Mechanical Engineering, U-M College of Engineering, is a pioneer with years of practical experience in the development, application, and manufacture of biologically-inspired compliant mechanisms and systems. One of his areas of expertise is the formulation of design algorithms to systematically generate optimal compliant structures. He received his M.S. and Ph.D. degrees from the University of Minnesota.

**CHARLES KIM, Ph.D.** Assistant Professor of Mechanical Engineering, Bucknell University, is currently studying intuitive approaches to compliant mechanism synthesis and their practical implementation in biomimetic and consumer applications. He received his B.S. from Caltech and his M.S. and Ph.D. from the University of Michigan.

**JAMES D. ERVIN, Ph.D.** is a mechanical design consultant at FlexSys. His background includes work in design and manufacturing on automotive actuators; R&D product development on magnetic FEA, structural FEA, structural design, fabrication, and testing on active balance control devices; and powertrain research focusing on electromechanical systems. He received his B.S. from Lawrence Technological University and his M.S. and Ph.D. from the University of Michigan.

$1,895* COVERS THE ENTIRE PROGRAM
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*Program fees at the time of brochure printing. Check our current program fee schedule at InterPro.engin.umich.edu. Fees are subject to change.
COMPLIANT DESIGN FLEXES TO FUNCTION

Fewer Parts = Reduced Cost + Increased Quality
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Michigan Engineering
University of Michigan College of Engineering
Interdisciplinary Professional Programs
2401 Plymouth Road, Suite A
Ann Arbor, MI 48105-2193
(734) 647-7200 | (734) 996-6127 (fax)

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Jula Donovan Darlow, Ann Arbor
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[Indicates programs with an online delivery option.]

Graduate Certificates of Advanced Studies in Engineering (CASE) are also available in some of the programs.

Professional development short courses and certification programs include:
- Six Sigma for product development, manufacturing, and services
- Lean for manufacturing, healthcare and pharmaceuticals, logistics, office and product development

Visit our website at InterPro.engin.umich.edu for information on this and other Michigan Engineering programs:
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- Lean Office & Business Processes Certificate Program
- Lean Healthcare
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Streamlined Compliant Systems Morph without Joints or Hinges, Providing a Whole New Way to Solve Problems

ALMOST ANY PRODUCT CAN BE CONSIDERED FOR A NO-ASSEMBLY DESIGN APPROACH USING COMPLIANT MECHANISMS

Bring a real-life problem from your workplace to this hands-on class and develop a functional prototype using biologically-inspired design principles

Above: An example of biologically-inspired compliant design, this iris is cast as a single piece that opens and closes by applying force to the small extensions on the outer rings.

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2008 PROGRAM DATE
October 13–14
Ann Arbor, Michigan

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