AEROSPACE & MECHANICAL ENGINEERING

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UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: **Professor Mary Frecker**
Department of Mechanical and Nuclear Engineering
Penn State University
University Park, Pennsylvania

TOPIC: **OPTIMAL DESIGN OF CONTACT-AIDED COMPLAINT MECHANISMS**

DATE: Tuesday, October 02, 2012

TIME: 3:30 p.m.

PLACE: Lower Level Auditorium, Geddes Hall

Reception: 3:00 – 3:30 p.m. – Coffee House, Geddes Hall

ABSTRACT

Compliant mechanisms achieve force and motion transmission through elastic deformation of flexible members. This seminar will focus on optimal design of compliant mechanisms which use self-contact to improve performance. One example is a novel compliant spine designed for passive shape change in flapping wing unmanned aerial vehicles. A design optimization procedure was developed to tailor the performance of the compliant spine for specific flapping kinematics. Nonlinear stiffness of the compliant spine is achieved by incorporating self-contact, allowing the compliant spine to be much stiffer during the downstroke than upstroke. These passive compliant mechanisms are designed to deform as a natural consequence of the aerodynamic loads encountered during flight, and therefore there is no need for added weight and complexity of actuators and sensors. Prototype fabrication and testing was conducted and it was found that incorporation of the compliant spine into the leading edge spar of an avian-scale ornithopter resulted in improvement in lift and reduced power consumption.

Another application in which contact-aided compliant mechanisms are beneficial is in minimally invasive surgery, where miniature surgical instruments are used through small incisions or through the working channel of a flexible endoscope. A meso-scale compliant forceps instrument was developed that uses self-contact to provide stress relief, thus improving the performance. Here a meso-scale compliant mechanism is defined as having millimeter-sized overall dimensions and micrometer-sized features. A design optimization routine was developed to maximize tool performance while fulfilling surgical and manufacturing requirements. The mechanical performance of the meso-scale tool tips was measured and compared to FEA predictions. Prototype instruments were also evaluated in surgical simulation using a newly developed set of tasks designed to evaluate both instruments and surgical skill in Natural Orifice Translumenal Endoscopic Surgery.

NOTE: ***If you are interested in meeting individually with Prof. Frecker, please contact Linda at 631-5431***