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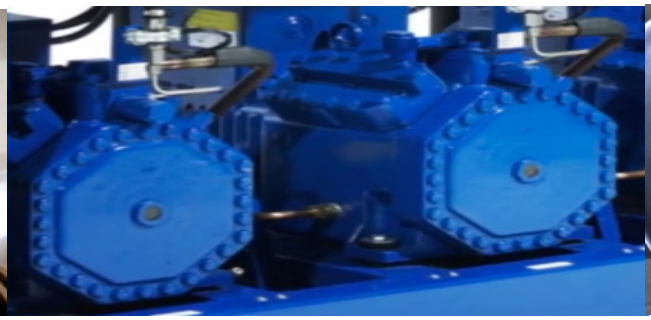
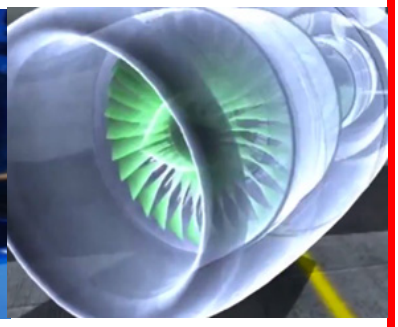

Satyandra K. Gupta
Maryland Robotics Center
University of Maryland, College Park

Robo Raven:
A Flapping Wing Air Vehicle with Compliant and Independently Controlled Wings

Thursday, March 19, 2015 10 a.m. – 12:00 p.m. Storrs Campus, ITEB 336

Abstract: Unmanned aerial vehicles can be broadly classified into rotorcraft, airplanes, and flapping wing air vehicles (FWAVs). Generally, rotorcrafts are best suited for low speeds and hovering, having excellent maneuverability, but limited endurance. Airplanes are best suited for higher speeds and greater endurance, but they lack the maneuverability of rotorcraft. FWAVs may provide a versatile compromise between these two types while also offering safer and quieter operation. Most FWAVs use a single actuator to flap both wings. This couples and synchronizes motions of the wings, which only provides variable rate flapping at constant amplitude to control wing deformations. Independent wing control has the potential to provide a greater flight envelope through the ability to program wing motions to achieve a desired wing shape and associated aerodynamic forces. This approach requires the use of at least two actuators with position and velocity control that can be programmed to drive the wings independently. Integration of two actuators in a flying platform significantly increases weight and hence makes it challenging to achieve flight.

This seminar will begin with an overview of the design process for realizing a new FWAV with compliant and independently controlled wings. The design process began with the system architecture design and component selection. It was followed by wing design and flapping frequency optimization to generate the highest possible lift by realizing appropriate wing shapes during flapping and operating near the maximum power operating point for the selected actuators. The resulting design utilized additive manufacturing processes to minimize part count and weight. The seminar will also describe the new FWAV design called *Robo Raven*. It is capable of successfully performing dives, flips, and buttonhook turns demonstrating the capability afforded by the independently actuated and controlled wings. The seminar will conclude by describing the latest advances in *Robo Raven*. These will include multifunctional wings to harvest solar energy and flying autonomously.

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***Speaker Biography**:* Dr. Satyandra K. Gupta is a Professor in the Department of Mechanical Engineering and the Institute for Systems Research at the University of Maryland, College Park. He is the Director of the Advanced Manufacturing Laboratory and the Maryland Robotics Center. Prior to joining the University of Maryland, he was a Research Scientist in the Robotics Institute at Carnegie Mellon University. He served as a program director for the National Robotics Initiative at the National Science Foundation from September 2012 to September 2014.

Dr. Gupta's interest is broadly in the area of automation. He is specifically interested in automation problems arising in Engineering Design, Manufacturing, and Robotics. He is a fellow of the American Society of Mechanical Engineers (ASME). He has served as an Associate Editor for *IEEE Transactions on Automation Science and Engineering*, *ASME Journal of Computing and Information Science in Engineering*, *ASME Journal of Mechanism and Robotics*, and *SME Journal of Manufacturing Processes*.

Dr. Gupta has received several honors and awards for his research contributions. Representative examples include: a Young Investigator Award from the Office of Naval Research in 2000, a Robert W. Galvin Outstanding Young Manufacturing Engineer Award from the Society of Manufacturing Engineers in 2001, a CAREER Award from the National Science Foundation in 2001, a Presidential Early Career Award for Scientists and Engineers (PECASE) in 2001, Invention of the Year Award in Physical Science category at the University of Maryland in 2007, Kos Ishii-Toshiba Award from ASME Design for Manufacturing and the Life Cycle Committee in 2011, and Excellence in Research Award from ASME Computers and Information in Engineering Division in 2013. He has also received six best paper awards at conferences and 2012 Most Cited Paper Award from *Computer Aided Design Journal*.