



College of Engineering
Department of
Mechanical & Industrial Engineering

The Sidney E. Fuchs Seminar Series

3:30-4:30pm, Friday, April 26, 2013

Frank Walk Room



Project Firefly: Steps toward the Organic UAV

by **James E. Hubbard Jr., Ph.D.***

Langley Distinguished Professor
Aerospace Engineering; University of Maryland
National Institute of Aerospace

The Morpheus Laboratory at the National Institute of Aerospace has a strategic interest in pursuing a set of critical technologies and feasibility studies that establish a foundation for the future development of a practical organic aircraft. The technologies to be developed address the critical feasibility issues of 1) highly flexible multifunctional morphing structures 2) vehicle lift generation and control, 3) civil applications for multiple coordinated organic aircraft, and 4) the development of a practical integrated vehicle system.

An organic aircraft, which makes use of biological and evolutionary approaches to flight, has the potential to make many long-envisioned private sector uses for small autonomous air vehicles (SUAV) a reality. Within two decades, an organic vehicle may uniquely serve a civil aeronautics market niche by being safe enough, quiet enough, and agile enough to work in close proximity to people and property. The organic aircraft would be ecologically neutral, creating no emissions.

It will use highly flexible materials that enable the generation of lift and thrust without the need for bearings, linkages, or a separate propulsion system. Its multifunctional materials will improve flight efficiency. Its wings will gather and store energy, serve as an antenna, and host embedded sensors. The wings will generate lift and thrust through complex motions that actively adapt to the environment, guided by evolutionary computer algorithms. The aircraft will be capable of large configuration changes to create a wide flight envelope, from perching and hovering to high-speed tucked-wing dives. It would be intelligent, thereby enabling autonomous operations. Through advanced sensors, many of which would be integral to the multi-function materials used, it would adapt to changes in its health or its environment, offering protection to itself and those around it if failures occur. It will communicate with a larger system of vehicles and carry out coordinated multi-vehicle missions that are impossible today. Terrestrial missions may include search and rescue, neighborhood security, large-scale atmosphere sampling, and the detailed inspection of large structures.

Dr. Hubbard, Director and Founder of the Morpheus Laboratory, will present an overview of research results from Project Firefly. These results include new smart skin sensors, passive and active wing morphing architectures, advances in state space modeling of flapping wing vehicles for robust. Project Firefly is a flight based program to ultimately develop a solid state ornithopter for civil applications that include search and rescue, atmospheric data collection, wild fire fighting and crop surveys.

* Dr. Hubbard earned his B.Sc. M.Sc. and Ph.D. degrees from the Massachusetts Institute of Technology, all in Mechanical Engineering. He has been at the NIA and U. Maryland since August 2004.