



U.S. ARMY
RDECOM

Mission-Driven Microsystem
Design and Validation



open
campus

S&T Campaign: Sciences for Maneuver Platform Mechanics

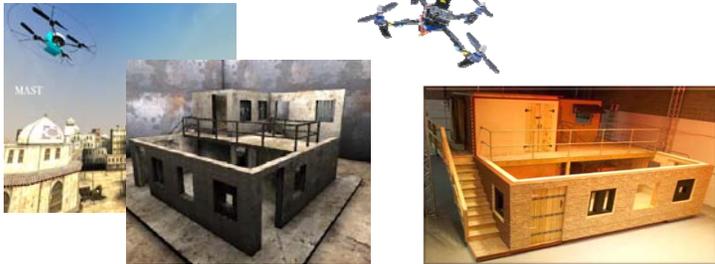
John Gerdes, (410) 278-8735, john.w.gerdes.civ@mail.mil

Eric Spero, (410) 278-8743, eric.spero.civ@mail.mil

Research Objective

In situ rapid manufacturing of unmanned aerial intelligence, surveillance, and reconnaissance (ISR) platforms with minimal set of components

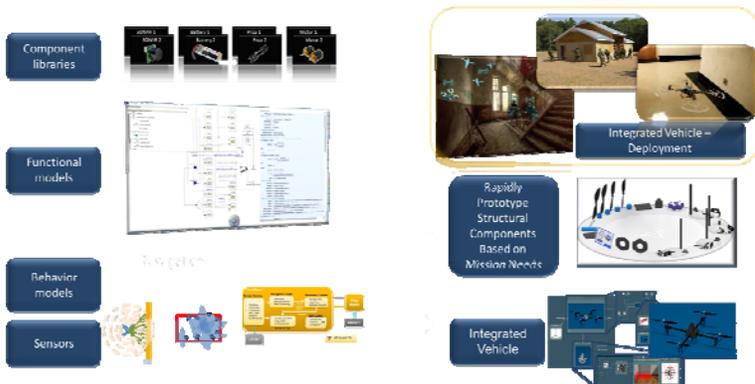
- Enhance previously developed framework to speed design and analysis process from months to days
- Explore how to scale a common vehicle platform and integrate with parts from small library to meet mission needs
- Experimental verification of virtual and physical vehicles



Virtual-to-Physical Experimentation

Challenges

- Reduction of design process cycle time
- Development of physics-based expressions for components and aerial vehicle system
- Validation of physics-based expressions with experimental (bench and flight) data
- Lack of standardization across printers, materials, and manufacturing techniques



Prototyping Vision: Components, Functions, and Behaviors Linked to Conceptual Design and Mission Modeling Tools

ARL Facilities and Capabilities Available to Support Collaborative Research

- Access to multifidelity microsystem conceptual design tools and techniques
- Access to microsystem rotorcraft and flapping wing technology subject matter experts
- Access to ARL Sensors and Autonomous Systems Experimental Facility

Status

- An initial interactive systems engineering process and tool have been developed
- Vehicle manufactured and flown based on output from design process
- Initial experimentation completed

Related Publications and Presentations

- Mangum P, Fisher Z, Cooksey KD, Mavris DN, Spero E, Gerdes J. An Automated Approach to the Design of Small Aerial Systems Using Rapid Manufacturing. ASME IDETC/CIE; 2-5 August 2015; Boston, MA: ASME; 2015.
- Roe RW, Ford ST, Cinar G, Mian Z, Mavris DN. A Multi-Disciplinary Integrated Design Environment for Requirements Development and Performance Evaluation of Autonomous Systems. 14th AIAA Aviation ATIO; 16-20 June 2014; Atlanta, GA: AIAA; 2014.
- Mian Z. A Multidisciplinary Framework for Mission Effectiveness Quantification and Assessment of Micro Autonomous Systems and Technologies. Atlanta, GA: Georgia Institute of Technology; 2013.
- Mian Z, Mavris DN. Mission Effectiveness Quantification and Assessment of Micro Autonomous Systems and Technologies. IEEE Systems and Information Engineering Design Symposium; 26 April 2013; Charlottesville, VA: IEEE; 2013.

Complementary Expertise/Facilities/Capabilities Sought in Collaboration

- Development of interactive, web-based applications
- Application of statistical techniques to quantify technology impacts based on empirical data
- Multiple stakeholder interactions and value negotiation
- Parameterization of computer-aided design (CAD) models
- Agent-based modeling and simulation
- Immersive, 3-D representation of environment, physical objects, and microsystem vehicles
- Advanced technology modeling and representation techniques
- 3-D printing of embedded electronics