Engineering

Employing expertise in electrical, mechanical, structural, thermal, aerodynamics, optical, controls, and software engineering to build, integrate, and test systems for application in the development of advanced technology prototypes

Leadership

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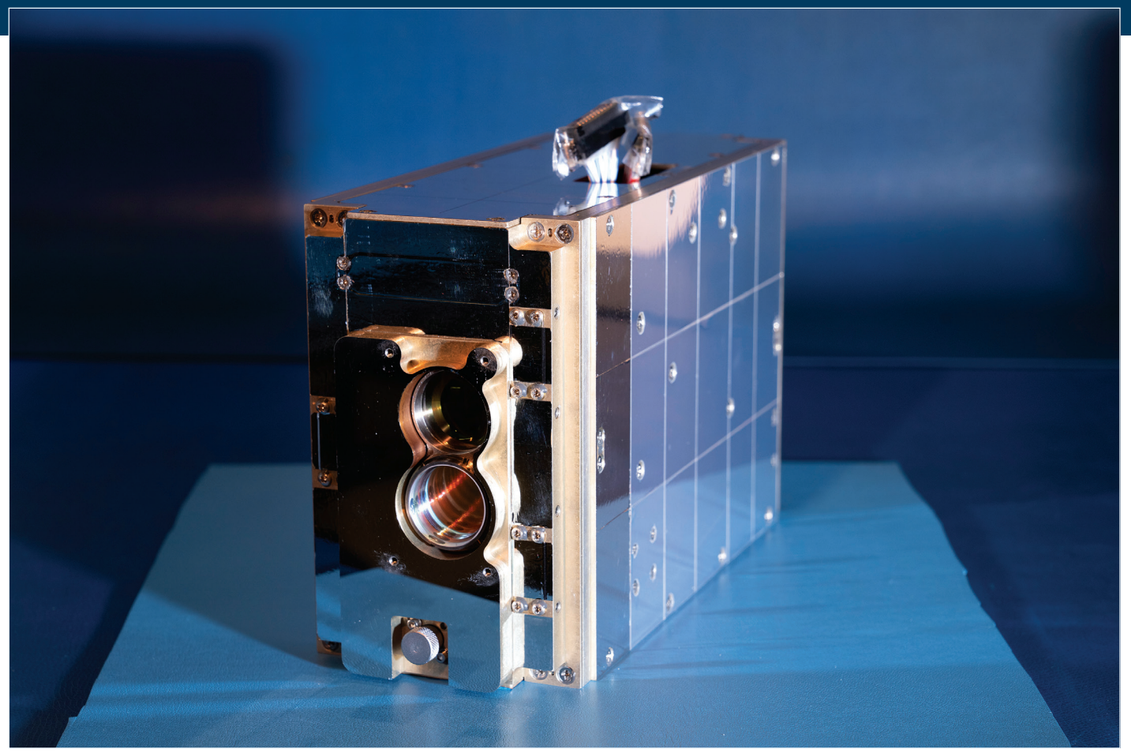

The Laboratory built a high-data-rate laser communication terminal for NASA to demonstrate 200-gigabits-per-second transmission from low-Earth orbit to a ground station. This 3U CubeSat terminal weighs 3 kilograms, has 2 terabytes of storage, and requires 100 watts of power to operate.

Principal 2021 Accomplishments

- The Laboratory established the Digital Engineering Center to lead and coordinate the development and adoption of modern digital engineering practices to enhance prototyping capabilities, conduct novel research in digital engineering, and act as a resource for the Department of Defense and broader Laboratory sponsor community.
- The Laboratory adopted an operations strategy for mechanical and electrical parts fabrication by increasing value through an environment focused on continuous and incremental process improvement.
- The development of future hypersonic interceptors and systems was enhanced by the development of unique modeling and design techniques. A state-of-the-art integrated simulation framework that optimizes the shape and materials of a vehicle on the basis of its aerodynamic and thermal behavior was prototyped over the past year. This algorithm capability is being actively transitioned and adopted by various external organizations.
- The Laboratory created flight software and firmware to accelerate the development of unmanned air vehicles. State-of-the-art algorithms have been implemented to run on a single central processing unit without the use of a microcontroller to provide unified support for all common unmanned aerial vehicle types including multirotors, fixed wings, and vertical take-off and landings.
- Using in situ closed-loop feedback error correction during diamond turning of optical substrates, the Laboratory developed techniques that allow increased resolution of optical systems with the use of freeform designs.
- The Laboratory increased its use of augmented and mixed reality technologies—including during assembly, integration, and testing—to enhance remote collaboration on projects and to accelerate the development of prototype hardware.
- The Laboratory is helping organizations identify capability gaps and solutions for warehouse modernization and automation by performing readiness assessments for technologies including inventory drones, automated storage, and autonomous materiel handling, such as self-driving fork lifts and robotic arms enabled by machine learning.

Future Outlook

The Laboratory will increase its use of digital engineering to accelerate prototyping by integrating model-based practices into end-to-end prototyping workflow; leveraging shared data, models, and enhanced simulations; and using high-performance computing and artificial intelligence. The Laboratory will also extend connections to relevant Department of Defense strategic efforts to streamline the development of fully integrated platforms and deliver capabilities more rapidly with digital engineering practices.

The new Engineering Prototyping Facility is scheduled to open in 2027 and will provide a modern building that will more efficiently and effectively support the increasingly complex and challenging prototyping needs of the nation. The division is working with architecture firms that will provide the detailed design of the building and manage equipment moves. Construction is expected to start in 2025.

Mustang

Mustang is a bidirectional space-to-ground laser communication system built by Lincoln Laboratory that features a highly integrated mechanical and electrical design that provides a 10-megabits-per-second downlink capability from geosynchronous orbit and a 2-kilobits-per-second uplink capability from the ground. The payload mass is less than 5 kilograms, and it requires approximately 11 watts of unregulated bus power to operate. A micro-gimbal on the payload enables a large 2π steradian field of regard with a pointing stability of 20 microradians. A technology demonstration unit was delivered in July 2021.