Fact Sheet

Defense Advanced Research Projects Agency

3701 North Fairfax Drive
Arlington, VA 22203-1714

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DARPA NANO AIR VEHICLE PROGRAM

The objectives of the Defense Advanced Research Projects Agency (DARPA) Nano Air Vehicle (NAV) program are to develop and demonstrate an extremely small (less than 7.5 cm wingspan), ultra-lightweight (weighing less than 10 grams) air vehicle system with the potential to perform indoor and outdoor military missions in challenging environments.

The initial 18-month phase of the program ended in spring of 2008. During the first phase, four contractors; AeroVironment Inc., Charles Stark Draper Laboratory, Lockheed Martin Advanced Technology Laboratories, and MicroPropulsion Corp; developed technologies for lift generation and vehicle control via rotating and flapping wings, advanced stability and control using video images, and analytical tools for developing low Reynolds number aircraft. The contractors also conducted trade studies, risk mitigation testing and demonstrations, and completed preliminary designs of their vehicle concepts.

Based on the results of the initial phase, DARPA selected AeroVironment to continue developing its Nano Air Vehicle design. The continuing design effort by AeroVironment, which will be completed in no more than 6 months, will focus on further development of critical aspects of their flapping wing concept. If the additional development work is successful, an 18-month long detailed design effort will be initiated and conclude with prototype system fabrication and flight demonstrations.

"The NAV program will push the limits of aerodynamic and power conversion efficiency, endurance and maneuverability for very small air vehicle systems," explained Dr. Todd Hylton, DARPA program manager. "We are interested in a system that has 20 minutes of flight time, can withstand 2.5 meters per second wind gusts, can operate inside buildings and have up to a kilometer command and control range." In addition, the vehicle would be able to hover while carrying a payload.

Nano air vehicles will be revolutionary in their ability to harness flapping wing, low Reynolds number physics, navigate in complex environments, and communicate over significant distances. Flight-enabling nano air vehicle system technologies being developed in the program include:

- Aerodynamic design tools to achieve high lift-to-drag airfoils;
- Lightweight, efficient propulsion and power subsystems; and
- Advanced manufacturing and innovative subsystem packaging and configuration layout.

The program will continue to develop conformal, multifunctional structural hardware and strong, light, robust aerodynamic lifting surfaces for efficient flight at low Reynolds numbers

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(<15,000). In addition, researchers will remain focused on developing advanced technologies that enable collision avoidance and navigation systems for use in GPS-denied indoor and outdoor environments and improving efficiency and stability in hovering flight and during the deployment or emplacement of sensors.

Tailless design

AeroVironment's concept is a remote-controlled NAV called "Nano SCOUT" or Nano Sensor Covert Observer in Urban Terrain. It is a bird-like flapping design similar to a hummingbird. Their NAV design will use flapping-wing propulsion from an all-electric power-train that is intended to propel the vehicle at 20 miles per hour in a dash mode, and slow it down to one mile per hour for precision navigation inside buildings. The vehicle will be designed to hover as well as take off and land vertically. Projected total flight endurance is 11 to 20 minutes, depending on battery development. During the initial program phase, researchers have developed a conceptual design concentrating on the very difficult tasks of fabricating micro-flapping-wings, as well as aircraft control through wing manipulation. They will continue developing this design, adding details to subsystems and performing further demonstrations of the wing flapping control scheme. The flapping wing control scheme is critical since it provides all of the control for the aircraft. Other team members include University of Illinois at Urbana-Champaign, Duke University, and Irvine Sensors.

Media with questions, contact Jan Walker, (703) 696-2404, or jan.walker@darpa.mil. For higher resolution images, please contact AeroVironment. Military organizations interested in this technology should contact Dr. Todd Hylton, (703) 526-4056 or todd.hylton@darpa.mil.