NASAfacts

Space Technology
Game Changing Development
NASA Affordable Vehicle Avionics (AVA)

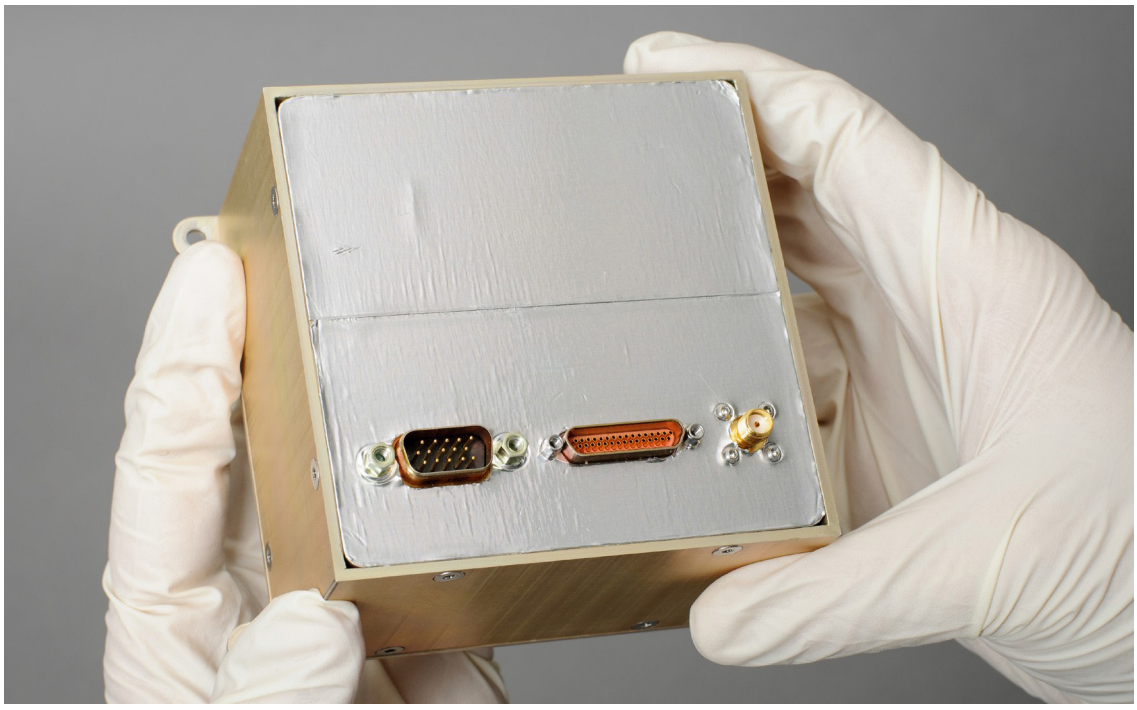
Common Modular Avionics System for Nanolaunchers Offering Affordable Access to Space

Small satellites are becoming ever more capable of performing valuable missions for both government and commercial customers. However, currently these satellites can be launched affordably only as secondary payloads. This makes it difficult for the small satellite mission to launch when needed, to the desired orbit, and with acceptable risk.

What is needed is a class of low-cost launchers, so that launch costs to low-Earth orbit (LEO) are commensurate with payload costs.

Several private and government-sponsored launch vehicle developers are working toward just that—the ability to affordably insert small payloads into LEO. But until now, cost of the complex avionics remained disproportionately high. AVA solves this problem.

Significant contributors to the cost of launching nanosatellites to orbit are the avionics and software systems that steer and control the launch vehicles, sequence stage separation, deploy payloads, and telemeter data. The high costs of these guidance, navigation and control (GNC) avionics systems are due in part to the current practice of developing unique, single-use hardware and software for each launch. High-performance, high-reliability inertial sensors components with heritage from legacy launchers also contribute to costs—but can low-cost commercial inertial sensors work just as well?



AVA controller is small, light in weight, and economical to fly.

NASA Ames Research Center has developed and tested a prototype low-cost avionics package for space launch vehicles that provides complete GNC functionality in a package smaller than a tissue box (100 mm × 120 mm × 69 mm; 4 in x 4.7 in × 2.7 in), with a mass of less than 0. (2 lb). AVA takes advantage of commercially available, low-cost, mass-produced, miniaturized sensors, filtering their more noisy inertial data with real-time GPS data. The goal of the AVA project is to produce and light-verify a common suite of avionics and software that deliver affordable, capable GNC and telemetry avionics with application to multiple nanolaunch vehicles at 1% the cost of current state-of-the-art avionics.

In the test lab, the AVA has been successfully demonstrated to survive the launch environment. Simulations using digital models of rockets guided by AVA demonstrate that it achieves all functional requirements under a variety of simulated launch conditions.

What remains is to test the AVA in an actual light environment to validate the navigation and attitude determination performance in actual conditions. An "Improve, Test, Fly, Improve" iterative design cycle approach will be employed. Planned light tests in summer and early fall 2015 include the Marshall Space Flight Center (MSFC) nanolauncher and UP Aerospace SL XL, respectively. After proving its "open loop" capability, where AVA is not actively controlling the rocket, the software functions can be readily "tuned" for a wide range of different launch vehicles using a streamlined "cookbook" approach. AVA will ultimately be subjected to rigorous closed loop performance tests leading to control of a rocket to orbit. AVA technology will then be made available to the small launch vehicle industry.

The AVA project is based at NASA Ames Research Center, Moffett Field, California. It is managed by the Engineering Directorate and is funded by the Space Technology Mission Directorate's (STMD) Game Changing Development (GCD) Program. Marshall Space Flight Center provides the nanolauncher for testing in 2015 as well as GNC expertise.

The GCD Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space.

AVA controller is smaller than a stack of 6 compact disc cases, and weighs in at under a kilogram—batteries included!

For more information about STMD's GCD, visit:
gameon.nasa.gov

For more information about the Ames Engineering Directorate, visit:
http://www.nasa.gov/centers/ames/engineering/

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