

Affordable Vehicle Avionics (AVA) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)



ANTICIPATED BENEFITS

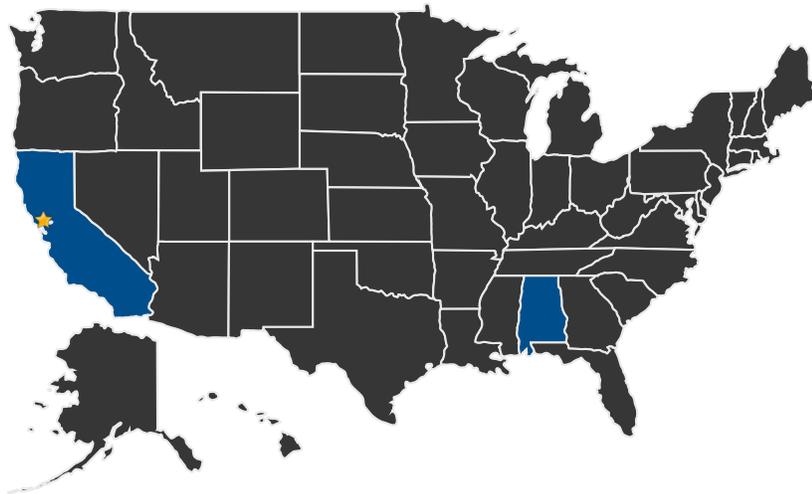
To NASA funded missions:

This technology will benefit the STMD ELaNa Program and CubeSat Launch Initiative and the STMD Flight Opportunities Program.

DETAILED DESCRIPTION

AVA technology will guide and control a class of small launchers with state-of-the-art precision, at a cost 2 orders of magnitude lower than conventional GNCs. Using AVA technology, commercial "nanolaunch" providers will offer launch services to insert nano-satellites (up to 25kg) into LEO at rates commensurate with payload cost. AVA enables nanosat providers, as primary payloads, to determine their own launch date and orbit specifications, rather than depend on a ride-share.

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work

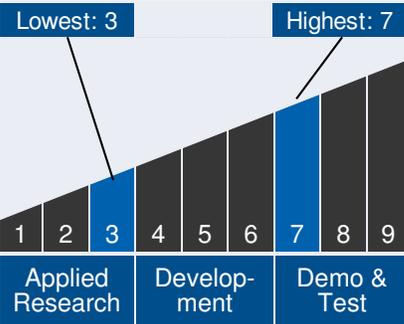
★ Lead Center: Ames Research Center



Table of Contents

- Anticipated Benefits 1
- Detailed Description 1
- U.S. Work Locations and Key Partners 1
- Technology Maturity 1
- Management Team 1
- Technology Areas 2
- Details for Technology 1 2
- Technology Areas 2
- Details for Technology 2 3

Technology Maturity



Management Team

Program Executive:

- Lanetra Tate

Program Manager:

- Mary Wusk

Continued on following page.

Affordable Vehicle Avionics (AVA) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)



Other Organizations Performing Work:

- Millennium Engineering and Integration
- UP AEROSPACE INC

Management Team (cont.)

Project Manager:

- James Cockrell

Principal Investigator:

- Ronald Litchford

Technology Areas

- Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)
- Position, Navigation, and Timing (TA 5.4)
- Deep-Space Positioning System (DPS) (TA 5.4.2.8)
- Robust Mission Requirements Modeling (TA 11.2.5.3)
- Aeronautics (TA 15)

DETAILS FOR TECHNOLOGY 1

Technology Title

Guidance, Navigation and Control

Technology Description

This technology is categorized as a hardware subsystem for unmanned spaceflight

Low-cost, capable GN&C capable of guiding a nano-launcher into Low Earth Orbit.

Capabilities Provided

Low-cost, capable GN&C capable of guiding a nano-launcher into Low Earth Orbit.

Potential Applications

Low-cost, capable GN&C capable of guiding a nano-launcher

Technology Areas

Primary Technology Area:

Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)

└ Position, Navigation, and Timing (TA 5.4)

└ Onboard Auto Navigation and Maneuver (TA 5.4.2)

└ Deep-Space Positioning System (DPS) (TA 5.4.2.8)

Continued on following page.

Affordable Vehicle Avionics (AVA) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)



into Low Earth Orbit.

Performance Metrics

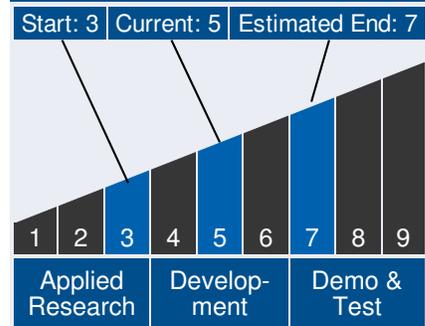
Metric	Unit	Quantity
cost	\$	\$20k
Mass	kg	2.0
volume	cm ³	2000

Technology Areas (cont.)

Additional Technology Areas:
Modeling, Simulation, Information Technology and Processing (TA 11)

- └ Modeling (TA 11.2)
 - └ Frameworks, Languages, Tools, and Standards (TA 11.2.5)
 - └ Robust Mission Requirements Modeling (TA 11.2.5.3)

Technology Maturity



DETAILS FOR TECHNOLOGY 2

Technology Title

Novel Extended Kalman Filter to integrate sampled GPS position and velocity data with low-cost but inherently noisy, high-drift COTS inertial measurement unit (IMU) real-time sensors for low cost GN&C during launcher ascent.

Technology Description

This technology is categorized as firmware for unmanned spaceflight

Novel Extended Kalman Filter to integrate sampled GPS position and velocity data with low-cost but inherently noisy, high-drift

Technology Areas

Secondary Technology Area:
Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)

Additional Technology Areas:
Aeronautics (TA 15)

Affordable Vehicle Avionics (AVA) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)



COTS inertial measurement unit (IMU) real-time sensors for low cost GN&C during launcher ascent.

Capabilities Provided

Novel Extended Kalman Filter integrates sampled GPS position and velocity data with low-cost but inherently noisy, high-drift COTS inertial measurement unit (IMU) real-time sensors for low cost GN&C during launcher ascent.

Potential Applications

Enables very low-cost but high-performance nano-launch vehicles.

Performance Metrics

Metric	Unit	Quantity
Flight Path Angle knowledge error	deg	0.5
Standard deviation velocity knowledge uncertainty at upper stage burnout	m/s	24
End-of-boost attitude knowledge error	deg/axis	5.0
cost to integrate with LV	\$	100k

