Guidance, Navigation and Control Beyond Low Earth Orbit (LEO)

Lead Center: GSFC
Participating Center(s): JPL

Envisioned NASA science missions will increasingly use large, and/or distributed, observatories in orbits beyond LEO. Advanced Guidance Navigation and Control (GN&C) technology is required for these platforms to address high performance and reliability requirements while simultaneously satisfying low power, mass, volume and affordability constraints. In particular, there are many technology gaps in challenging orbital environments, including highly elliptical Earth orbits, libration point orbits, and lunar and planetary orbits. A vigorous effort is needed to develop guidance, navigation and control methodologies, algorithms, and sensor-actuator technologies to enable revolutionary science missions. Of particular interest are highly innovative GN&C technology proposals directed towards enabling scientific investigators to exploit new vantage points, develop new sensing strategies, and implement new system-level observational concepts that promote agility, adaptability, evolvability, scalability, and affordability. Specific areas of research include:

**Precision Pointing**
Innovative GN&C solutions for scientific instrument and laser communication system pointing, tracking, and stabilization are sought. Proposals that exploit and combine recent advances in attitude determination and control, lasers, advanced electro-mechanical packaging are encouraged. Proposed NASA science missions provide applications with pointing accuracies of 3 microradians or less with jitter of 30 nanoradians or less.

**Formation Flying**
Novel approaches to autonomous sensing and navigation of multiple distributed space platforms are sought. Of particular interest are sensing systems for formation, relative navigation and attitude. Proposed NASA science missions provide applications with relative range accuracies of 1 cm or less over formation scales of several km.

**Low Impact Sensors and Actuators**
GN&C sensors and actuators such as Sun sensors, Earth sensors, star/celestial object trackers, fine guidance sensors, gyroscopes, accelerometers, magnetometers, reaction/momentum wheels, control-moment gyros, magnetic torquers, tethers, attitude control thrusters, etc are sought. Of particular interest are technologies that will provide a sensing or actuation function, having performance (e.g., dynamic range, stability, accuracy, noise, sensitivity, bandwidth, control authority, etc.) consistent with the state-of-the-art, but with significantly reduced impact (mass, power, volume, and cost) to the host spacecraft. These resource reduction improvement factors should be quantified in the proposal and show a minimum factor of 2 with a goal of 10 or greater.