S2.01  Precision Spacecraft Formations for Telescope Systems

Lead Center: JPL

Participating Center(s): GSFC

This subtopic seeks hardware and software technologies necessary to establish, maintain, and operate precision spacecraft formations to a level that enables cost effective large aperture and separated spacecraft optical telescopes and interferometers. Also sought are technologies (analysis, algorithms, and testbeds) to enable detailed analysis, synthesis, modeling, and visualization of such distributed systems.

Formation flight can synthesize large effective telescope apertures through, multiple, collaborative, smaller telescopes in a precision formation. Large effective apertures can also be achieved by tiling curved segments to form an aperture larger than can be achieved in a single launch, for deep-space high resolution imaging of faint astrophysical sources. These formations require the capability for autonomous precision alignment and synchronized maneuvers, reconfigurations, and collision avoidance. The spacecraft also require onboard capability for optimal path planning and time optimal maneuver design and execution.

Innovations are solicited for: (a) development of nanometer to sub-nanometer metrology for measuring inter-spacecraft range and/or bearing for space telescopes and interferometers (b) development of combined cm-to-nanometer-level precision formation flying control of numerous spacecraft and their optics to enable large baseline, sparse aperture UV/optical and X-ray telescopes and interferometers for ultra-high angular resolution imagery. Proposals addressing staged-control experiments which combine coarse formation control with fine-level wavefront sensing based control are encouraged.

Innovations are also solicited for distributed spacecraft systems in the following areas:

- Distributed, multi-timing, high fidelity simulations;
• Formation modeling techniques;
• Precision guidance and control architectures and design methodologies;
• Centralized and decentralized formation estimation;
• Distributed sensor fusion;
• RF and optical precision metrology systems;
• Formation sensors;
• Precision microthrusters/actuators;
• Autonomous reconfigurable formation techniques;
• Optimal, synchronized, maneuver design methodologies;
• Collision avoidance mechanisms;
• Formation management and station keeping.