

## **New Millennium ST6 Autonomous Rendezvous Experiment (ARX)**

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This Paper presents an overview of the New Millennium Space Technology 6 (ST6) Autonomous Rendezvous Experiment (ARX) mission and system. ARX is to be hosted as a payload on the United States Air Force Research Laboratory (USAFRL) XSS-11 spacecraft. Launch is currently planned for the Fall of 2004 as a secondary payload on the Space Shuttle. The objective of the experiment is to demonstrate and characterize an autonomous rendezvous system that autonomously locates and rendezvous with a passive object. For this experiment, the object is approximately a sphere of 20 cm diameter and simulates the current concept of the Mars Sample Return mission's Orbiting Sample (OS) canister. The XSS-11 spacecraft will carry the OS into orbit, and deploy it at the start of the experiment. The experiment will execute a host of different proximity operations, including a number of different transfer maneuvers, approach profiles and fly-arounds of the OS.

The Rendezvous System is centered around a light-weight, low-power scanning Laser Mapper (LAMP) sensor that provides high accuracy angle and range information. This information is used by the ARX state estimation algorithms to autonomously compute the relative position and velocity of the spacecraft with respect to the OS. Based on an uploaded list of desired waypoints, the ARX rendezvous guidance algorithms autonomously compute maneuver and attitude requests that guide the spacecraft to the desired state. These maneuver requests are then sent to the host spacecraft for execution. The LAMP software as well as the ARX guidance and estimation algorithms are hosted on the LAMP processor and communications with the spacecraft are over the LAMP's RS-422 serial interface.

The demonstrated rendezvous technology is applicable to all future planetary sample return missions, including the Mars Sample Return Mission planned for the next decade. These missions will rely heavily on novel sensor technologies and autonomous navigation and guidance capabilities such as the ones demonstrated in the ST6 ARX. The operational experience gained from this experiment will benefit the design of future autonomous rendezvous and sample capture missions and systems where little or no 'ground-in-the-loop' control may be possible.