Robust Sensing for Autonomous Rendezvous and Docking
by
José Padial

The overall research goal is to enable a new capability to rendezvous and dock autonomously with an aggressively tumbling target (e.g. disabled satellite or space debris) for which we have little or no prior information. In particular, the aim is to enable this new capability for small satellite missions.

A motivating mission is to accomplish repair or de-orbit of an uncommunicative target by use of a servicing system composed of a small satellite chaser and a larger servicing satellite. Following deployment from the larger servicing satellite, the chaser docks autonomously with the target. Once docked, the small satellite vehicle, equipped with an IMU, broadcasts target motion data to the larger servicing vehicle to assist its safe dock with the target. A key technological hurdle for reliable chaser rendezvous and docking is the development of robust methods for relative pose estimation and target reconstruction.

Our approach is to develop and demonstrate both offline and real-time algorithms for fusing visual imagery and range data in a simultaneous localization and mapping (SLAM) framework that will enable estimating both the shape of a target (i.e. reconstruction) and its pose relative to the chaser satellite. Robustness of algorithms to sensor noise, in particular to lighting variation, will be a top priority.

This approach significantly extends work in the Stanford Aerospace Robotics Laboratory (ARL) in target reconstruction and relative pose estimation for rendezvous, and will heavily rely on experimental testing and demonstrations on existing ARL hardware platforms.