

## **Covariance Analysis Tool For Far Orbital Rendezvous**

### **Abstract**

Non-cooperative rendezvous is a key aspect of space debris removal, which will be very important in the next decades as the number of orbiting objects continues to grow rapidly. In this paper, emphasis is placed on navigation concerns during non-cooperative far rendezvous. Indeed, navigation performances are mainly limited in case of angles-only navigation by the fact that the chaser/target range is not observed, resulting in an infinite set of possible homothetic relative.

A covariance analysis tool is developed in order to analyze the impacts of thrust maneuvers, trajectory profiles, and sensor suite performance on the observability of the relative target/chaser position and velocity. The tool is different from current rendezvous navigation tools by dynamics based on Clohessy-Wiltshire equations and a modelisation of expended sensor suite: IMU, star tracker, optical and infrared camera and a LIDAR system. Thus, the analysis tool is based on a 39-state Extended Kalman filter comprised of the relative position and velocity errors, the absolute chaser attitude error, and the main sensor defects.

Sensitivity studies compare the performance of various navigation architectures and rendezvous trajectory profiles with thrust maneuvers. In addition, results enable to determine the parameters of interest for navigation sizing of future Monte Carlo navigation tool for far rendezvous.