Bearings-Only Rendezvous with Enhanced Performance

Employing only bearing/angular measurements for navigation during the far to medium range rendezvous with a non-cooperative target has several advantages with respect to directly measuring the range using active sensors such as RADAR or LIDAR. Angular measurements can be acquired using simple sensors such as a single optical camera, significantly reducing the mass and power requirements. Nevertheless, several challenges arise form the lack of a direct range measurement, which renders the problem instantaneously unobservable. The execution of known maneuvers is thus necessary to introduce observability in the estimation problem, which results in the navigation performance being directly dependent on the trajectory followed. A few single-maneuver schemes have been proposed to enhance bearings-only navigation performance. Nonetheless, little research has been published on the use of on-line trajectory optimization methods accounting for observability on the complete rendezvous trajectory. This paper presents the non-linear simulation results of a Model Predictive Control architecture for rendezvous that simultaneously enhances bearings-only observability in order to improve navigation performance. A detailed simulation environment provided by Thales Alenia Space France is used to show that the proposed scheme based on linearized equations displays satisfactory performance in a higher fidelity non-linear environment, when observability is considered in the trajectory optimization.