ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation, and Control (5)

Author: Prof. Mauricio Moshe Guelman
Asher Space Research Institute, Technion, I.I.T., Israel

Prof. Klaus Schilling
University Wuerzburg, Germany
Mrs. Danna Linn Barnett
Technion, I.I.T., Israel

FORMATION FLIGHT LINE OF SIGHT GUIDANCE

Abstract

There are several concepts of future space applications which require operating a satellite cluster in close formation, coordinated together to work as a single virtual satellite. The virtual platform concept enables enhancement of data collection, lowers total mission risk, and adds considerable flexibility to the mission. On the other hand formation flying requires increasing complexity in the mission control. The control approaches can be categorized into two main approaches: Impulsive and continuous control. Most of the published control works used GPS measurement for relative position determination. A few works considered the use of electro-optical means to measure the relative distance and angular velocity between the two satellites. The use of optical navigation is not new and has been used in the past, particularly in the areas of target tracking, interception, rendezvous and docking. Although much work has been done in this field, there are still unique challenges in space applications not faced in the more conventional applications. The active satellite observer is in orbit subject to the dynamics and constraints of space flight, the relative distance between the observer and target can range between thousands of kilometers to centimeters while performing a variety of possible relative maneuvers. Furthermore, in the space environment lighting conditions are of a strong varying nature. The potential of angles-only navigation is greatly enhanced when additional information beyond the standard line-of-sight (LOS) angles, including range and relative attitude information, is obtained from the object's image on the camera focal plane. In this work simple control laws based on optical measurements are developed. A leader – follower satellite configuration is considered with the satellites in low Earth orbits. A body fixed configuration for the optical and propulsion system in the chaser satellite is imposed to simplify the actual system implementation for small satellites. Only accelerations normal to the relative line of sight between the chaser and passive satellites are employed. These control laws enable an active chaser satellite to transfer autonomously from one relative elliptical orbit to another, using continuous low thrust engines.