

SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

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PRINCIPLE AND VERIFICATION OF NAVIGATION SHARING FOR SATELLITE CLUSTER

Abstract

Navigation data is extremely crucial for the normal flight and collision avoidance of the satellites that fly near to each other in space. To obtain its own navigation data, any satellite will rely on all kinds of sensors, for example, GPS receivers. For a single satellite, this is enough to maintain the daily onboard operation. However, for a group containing a large quantity of satellites, to avoid the collision, any satellite will require not only its own navigation data, but also other satellites' navigation data. To achieve this aim, the satellites in the group should exchange the navigation data with each other. This leads to a new technology, i.e. navigation sharing.

Navigation sharing means the transmitting, fusion, and sharing of the navigation data in a cluster of satellites. This concept is firstly mentioned by Owen Brown in 2006 and further researched by the current authors in 2012. However, navigation sharing as a new technology is still not pay enough attention.

In this paper, the strict definition of navigation sharing is proposed. It means that any satellite in a cluster can obtain all the satellites' absolute navigation data. Here absolute navigation data represent the inertial position and attitude, etc. To achieve the navigation sharing, the basic inter-satellite communication is necessary. This is recognized as a premise.

However, there are still a series of unsolved problems when considering navigation sharing in a cluster of satellites. First, what is the basic frame? In this paper, the server/client mode is adopted as the basic frame for navigation sharing. In this frame, a satellite with a powerful computer and antenna is selected as the server, and other satellites are recognized as clients. The clients report their positions and attitudes to the server and receive the navigation data of other satellites from the server. The server can store all the navigation data in its memory and broadcast this information to any satellite. Second, what is the type of transmitting navigation data? In this paper, the transmitting navigation data will be packed together with the name and measurement time of the corresponding satellite.

To show the rationality, a hardware-in-the-loop simulation system is built up, too. In this system, 4 satellites dynamics simulation computers and wireless communication transmitters are connected as a whole. The simulation results illustrate well the process of the navigation sharing.