Paper ID: 38052
student

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Technologies for Space Communications and Navigation (7)

Author: Ms. Qianbing Li
Tsinghua University, China

Dr. Shangyuan Li
Tsinghua University, China
Dr. Xiaoping Zheng
Tsinghua University, China
Dr. Bingkun Zhou
Tsinghua University, China

AN INTER-SATELLITE OPTICAL TRANSMISSION SYSTEM FOR SIMULTANEOUS RANGING AND DATA COMMUNICATION

Abstract

The operation of satellite navigation usually relies on the broadcast ephemeris from the ground control station. Under that circumstances, if the ground station failed to support, the satellite navigation would soon become paralyzed. Thus, autonomous navigation technology is carried out. Satellite autonomous navigation is performed through the bidirectional ranging and data exchange based on the inter-satellite links, automatically updating the long-term stored ephemeris and maintaining the operation and service capability of the system. Autonomous navigation technology ensures that satellite does not completely rely on the ground station, relieves the capacity stress of the uplink, and improves the navigation accuracy comparing with daily updated ephemeris.

To support satellite autonomous navigation, the inter-satellite link must guarantee the functions of precise ranging and data communication. Currently, the inter-satellite links mostly operate in the microwave band with positional precision at hundreds of meters and data rate at kilobit per second. To improve the accuracy of orbit determination and to acquire higher transmission speed, another alternative could be adopted: inter-satellite optical transmission, which had been verified by many countries.

In this paper, we present an inter-satellite optical transmission system for simultaneous precise ranging and high speed data communication. In the scheme, time division multiplexing is employed and a time frame is defined. Each time frame consists of a frame header which is a pseudo-random bit sequence (PRBS) for synchronization and precise ranging, and a frame body for communication data. The whole system works as follows: at terminal A, laser acts as the carrier for the multiplexed sequence transmitting in the deep space. Terminal B collects the laser beam and the collected beam is first detected to get the carried data, which is then divided into two branches: one is de-multiplexed locally to extract the communication data, and the other is regenerated and re-emitted to terminal A. Terminal A receives the light signal from terminal B and process it to acquire the PRBS for ranging. Thus, the proposed scheme builds up a half-duplex communication link which implements unilateral communication and bidirectional ranging simultaneously.

To validate the feasibility of the system, a principal experiment is conducted and experiment results show the system has the ability to get the bit error rate (BER) less than 10-10 at 2.5Gbps and the range resolution of 0.12m .