Paper ID: 7934
student

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Space Navigation Systems and Services (4)

Author: Dr. Shengchang LAN
Aalto University, Finland

Mr. Pan Rui
Harbin Institute of Technology, China
Mr. shi li
China
Prof. zhang jinxiu
Harbin Institute of Technology, China

TIME SYNCHRONIZATION OF SPACECRAFTS IN FORMATION FLYING BY PULSAR TIMING

Abstract

Pulsar signal as the source of the navigation information is beneficial in the navigation range and on the other hand independent from the usage license limitation, and meanwhile supplies synchronization, vehicle attitude and position information for spacecraft navigation. Analysis toward pulsar navigation perspectives and key technology breakthrough leads to a predominant position in competition. This paper aims to explore the pulsar navigation for formation flying spacecraft, mainly focus on pulsar signal identification, synchronization attitude relative ranging based on pulsar navigation, the details as follows. First of all, on the basis of current research statement, this thesis summarizes the research method and development of pulsars navigation for distributed satellite system, and then by analyzing the research method, this paper indicates the research direction of pulsars navigation for distributed satellite system in future researches. Secondly the paper discusses the pulsar classification according to the signal characteristic and the analysis covers the pulsar emission signals and spectrum characteristic which is the theoretical foundation of the pulsar identification and timing measurements. Then considering the synchronization of formation flying, the paper presents a method of time synchronization strategy which aims to improve the timing accuracy. A synchronization model is established and the error factors are analyzed. The pulsar timing residuals are caused by reference atomic clock and pulsar itself, and the two influences are not correlative. Filters such as wavelet and HHT are implementing to data handling and error analysis, and the paper investigated the wavelet multi-resolution analysis and wavelet packet analysis, and developed an ensemble pulsar time algorithm based on both of the HHT methods. The pulsar timing residuals are decomposed to different components with wavelet, and on the other hand the influences of different components are removed by HHT filtering, then the ensemble pulsar time can be obtained. Finally this paper comes to the conclusion of multi-pulsar observation is a key method to improve the accuracy. The method allows separating the error from a single pulsar timing errors and the pulsar itself in the post-fit pulsar timing residuals. The pulsar time can be obtained by filtering the observation residuals of pulsars observed, extracting the post-fit result of different pulsars, and then choosing the weight to timing aggregation.