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Author: Mr. Lue Chen
National Key Laboratory of Science and Technology on Aerospace Flight Dynamics, China,
luechen0912@yahoo.com.cn

Prof. Geshi Tang
Science and technology on aerospace flight dynamics laboratory, China, tanggeshi@bacc.org.cn
Ms. Fei Fan
Beijing Institute of Tracking and Telecommunication Technology (BITTT), China,
feifan1116@yahoo.com.cn
Dr. Lei LIU
1)Science and Technology on Aerospace Flight Dynamics Laboratory, China,2)Beijing Aerospace Control Center, China, China, 15810340789@139.com
Ms. Mei Wang
Science and technology on aerospace flight dynamics laboratory, China, wangmei@163.com
Ms. Li Li
Science and technology on aerospace flight dynamics laboratory, China, lili123@163.com
Ms. Huicui Liu
Science and technology on aerospace flight dynamics laboratory, China, liuhuicui@yahoo.com.cn

CHINA'S CE-2 LUNAR SATELLITE EXPERIMENT BASED ON SHORT BASELINE INTERFEROMETRY

Abstract

Interferometry technology is one of the most important methods for obtaining high precision navigation information in today's deep space exploration. It could obtain high precision spacecraft's angle information, which could overcome disadvantages that traditional ranging and doppler velocity measurement are only effective radio measurement methods line-on-sight, therefore, interferometry has been widely applied to deep space exploration missions. In China's Chang E (CE-1 and CE-2) lunar satellite flight missions, interferometry technology provided necessary supports for CE-1 and CE-2's precise orbit determination.

This paper describes the process of sampling CE-2 lunar satellite downlink signal for open loop interferometry by establishing a short baseline interferometry experiment system in Beijing Aerospace Control Center's antenna stations. Contrastively, short baseline system has some unique advantages compared with very long baseline interferometry system, for example, the two measurement stations have the same time and frequency source, this ensures that precise synchronization in two receiving antenna systems. In addition to that, transmitting medium error is avoided in short baseline interferometry system.The conclusions of testing for China's CE-2 lunar satellite based on short baseline interferometry are shown as follows:

(1)Clear interferometry fringes appear by analyzing CE-2 lunar satellite signal, and high precision delay and delay rate are obtained. The delay precision could reach 0.2 nanosecond.

(2)Taking long continuous observation experiment for CE-2 lunar satellite, the delay obtained by short baseline interferometry are compared with the delay obtained by post high precision orbit computing. The results shows that there is about 510 nanosecond deviation.After analyzing experiment system, it concludes that this deviation is caused by the different transmitting lead length in two receiving antenna

systems. Delay rate which is obtained respectively by short baseline interferometry and post high precision orbit computing, is coincident.

(3)In order to avoid system error in this short baseline interferometry experiment system, the fore-and-aft time differential delay is calculated. And the two differential delay is also compared, results shows that the mean value of differential delay residual is about 1 picosecond level, the precision (1σ) of differential delay residual is about 10 picosecond level. (4)The whole testing experiment indicates that the interferometry results based on short baseline system effectively validate the correctness of the interferometry methods and it could reach a high measurement precision. Simultaneously, this short baseline interferometry system could provide an effective experiment platform for validating China's future deep space interferometry technology.