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ACTIVITIES OF DELTADOR INTEROPERABILITY AND CROSS SUPPORT AT CHINA DEEP SPACE NETWORK

Abstract

China has conducted the third worldwide-distributed deep space network to support its lunar and deep space exploration. DeltaDOR is one of the key functions of China deep space network, since it could determine spacecraft angular position in the plane of sky. DeltaDOR is widely used in conjunction with conventional doppler and ranging data to improve spacecraft navigation, especially in the case of short-arc orbit determination. The distribution and length of the baselines are key factors of DeltaDOR measurement, so interoperability and cross support with multi space agencies is adopted to enhance deep space navigation. It could enhance navigation accuracy with more interferometry baselines and long baselines, besides, it could reduce pressure on limited antenna resources within inner-agency. In recent years, Beijing Aerospace Control Center(BACC) has conducted several DeltaDOR interoperability occasions with ESA. The first interoperability validation was conducted with ESA Venus Express in 2013, soon after two antennas of China deep space network has been put into application. The interoperability validation aimed at testifying the basic function of data record and translation, evaluating the performance of the software correlator developed in BACC. In order to make a preparation for cross-support in China first Mars mission Tianwen-1, BACC and ESA conducted interoperability testification with BepiColombo in 2019 to testify the performance of DeltaDOR interoperability and cross support, since some instruments of the system has been replaced in ESA tracking stations and correlator in BACC has also been updated. The formal DeltaDOR interoperability and cross support was conducted in China Mars mission Tianwen-1 under commercial contract, including eight sessions during the critical stages of the mission, such as Mars orbit insertion. This paper presents a brief introduction of China Deep Space Network and discusses the key algorithm adopted in DeltaDOR Interoperability and Cross Support. Results of the various validation steps undertaken between BACC and ESA are provided, especially, the details of tracking activities on Tianwen-1 are analysed in detail. These campaigns have shown that high performance DeltaDOR interoperability and cross support of China DSN could be used for future deep space exploration missions.