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Author: Dr. Yi Yusheng
Institute of Manned Space System Engineering,China Academy of Space Technology (CAST), China, yiyusheng@163.com

Prof. Hong Yang
China Aerospace Science and Technology Corporation (CASC), China, yang_hong@sohu.net
Mrs. xia yi
Institute of Manned Space System Engineering , China Academy of Space Technology, China, xiayi@163.com
Mrs. guo pei
Institute of Manned Space System Engineering , China Academy of Space Technology, China, guopei123@163.com
Mr. qi xin
Institute of Manned Space System Engineering , China Academy of Space Technology, China, qixin@sohu.com
Mr. Huang Cong
Institute of Manned Space System Engineering,China Academy of Space Technology (CAST), China, huangcong@163.com
Dr. wang yang
Institute of Manned Space System Engineering , China Academy of Space Technology, China, wangyang@sohu.com
Prof. chuanfeng wei
Institute of Manned Space System Engineering,China Academy of Space Technology (CAST), China, chfwei@163.com

A METHOD TO IMPROVE TT&C COVERAGE OF THE RELAY ANTENNA BASED ON CHINESE SPACE STATION

Abstract

In order to support taikonauts to conduct experiments and to transmit the experiment results to the ground stations in time, the Chinese Space Station needs to improve its telemetry, track and command (TTC) coverage. According to the geometry of relay satellites and the Space Stationthe bidirectional tracking rules for a tracking and data relay satellite (TDRS) and the Chinese Space Station are investigated based on classical orbital elements and the space station's attitude. The coverage of a TDRS over the Chinese Space Station with different mounting positions is calculated and simulated followed by the analysis of the relay antenna tracking peculiarities. A method that uses two antennas from different space station cabins and the way to adjust their mounting positions to improve TTC coverage are proposed. Both analysis and simulation are presented to demonstrate that the proposed method can expand the coverage effectively.

First, the theoretical foundations that supports the communication between TDRSS and spacecraft are presented. Considering the geometry of the TDRS1TDRS 2 and Chinese Space Station, we derived the calculating formula of tracking angle based on classical orbital elements and the space station's attitude.

Additionally, bidirectional tracking rules for the TDRS and Chinese Space Station is obtained.

Second, In the condition of existing relay antenna rotation capability and location of the three relay satellites of China, a simulation for the line of sight angles between Chinese Space Station and TDRS is conducted.

In the third part, a scheme that two antennas are installed is simulated. Considering the characteristic that the space station will be built via multi-cabin rendezvous and docking missions, the feasibility to improve TTC coverage by using two relay antennas and adjusting their mounting positions is proposed.

A conclusion is drawn in the last part. In order to obtain the maximum coverage for both single cabin spacecraft and the whole station, the relay antenna 1 and 2 installation angles should be 30 degree and 330 degree, respectively. The coverage can achieve a maximum of 87 percent for one single antenna and 100 percent for the entire space station. Both theoretic analysis and simulation results are presented to demonstrate that the method proposed in this paper can enhance the coverage value effectively.