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THE SHENZHOU MANNED SPACECRAFT RENDEZVOUS AND DOCKING GUIDANCE, NAVIGATION AND CONTROL DESIGN

Abstract

It is demanded, for Shenzhou manned spacecraft rendezvous and docking (RVD) guidance, navigation and control (GNC) system, fulfill all control tasks of RVD process, including carrying out the long-range remote orbit control strategy from Ground command, autonomously completing medium-range and short-range automatic measurement, navigation calculating, guidance strategies and realization. GNC system is composed of sensors, controllers and actuators: Sensors include relative navigation sensors, TV camera, the attitude measurement sensors and inertial measurement units. Controllers include GNCC (Guidance, Navigation and Control Computer) used for automatic control, and MCE (Manual Control Electronics) used for astronaut manual control. Actuators refer to the propulsion thrusters and control handles, including thrusters used for orbit control, translation control and attitude control, handles used for translation command and attitude command. Autonomous RVD process is divided into three working phases: homing phase, approaching phase and the last final closing phase. According to the relative navigation sensor measurement range and precision specification, the scheme is given that the relative navigation sensor fusion and navigation algorithm. It is given the guidance and control strategy for the respective working phase; In order to ensure the RVD mission success and developing complete RVD technology, it is designed that astronaut manual control of RVD within the range of 140 meters, besides automatic control of RVD. The key technologies in the development procedure and their solution are introduced. Finally, the RVD flight result of Shenzhou-8, Shenzhou-9 manned spacecraft with Tiangong-1 target spacecraft are given.