HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
Space Stations Assembly and Operations (3)

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SHORT RENDEZVOUS MISSIONS FOR ADVANCED RUSSIAN HUMAN SPACECRAFT

Abstract

The stay of crew in a limited inhabited volume of the "Soyuz-TMA" spacecraft during its two-day flight before docking to ISS is one of the most stressful parts of a human orbital space flight. In the paper a number of possible ways to reduce duration of the free flight phase are considered. The duration is defined by phasing strategy that is necessary for reduction of a phase angle between the chaser and target spacecraft at the chaser insertion time. Some short phasing strategies could be developed. The use of such strategies can create more comfortable transportation conditions for crew and additionally to provide possibility of spacecraft's life support resources saving. In the history of the Soviet manned space program can be observed a transition from the methods of direct spacecraft rendezvous with use of phasing for one orbit (first flights of "Vostok" and "Soyuz" vehicles) to currently used methods of two-day rendezvous mission. For advanced Russian human spacecraft we suggest to use the short phasing strategies, which can be considered as a combination between the direct and two-day rendezvous missions. It is assumed to use the following up-to-date technologies: onboard navigation; onboard calculations of phasing maneuvers; launch vehicle with high accuracy of spacecraft ascent, etc. In the paper some operational requirements and constraints for the strategies are briefly discussed. In order to provide acceptable phase angles for possible launch dates the experience of the ISS altitude profile control can be used. As examples of the short phasing strategies, the following rendezvous missions are considered: direct ascent, short mission with the phasing during 3 - 5 orbits depending on the launch date (nominal or backup), short mission with the phasing during a fixed number of orbits which correspond, for example, to a semi-diurnal interval. For each option statistical modeling of the rendezvous mission is fulfilled, as well as admissible phase angle range, accuracy of target state vector, and addition fuel consumption coming out of emergency is defined. In the paper an estimation of merits and demerits of all options is conducted.