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SPACECRAFT PILOTING PERFORMANCE ASSESSMENT – A COMPUTATIONAL EVALUATION METHODOLOGY FOR THE SIMSKILL EXPERIMENT

Abstract

Manual piloting of manned spacecraft during its diverse flight phases has become progressively less frequent as automated systems achieve better reliability. Nevertheless, the assessment and maintenance of piloting skills is still a crucial part of manned space missions. As an example, the final approach phase of Soyuz spacecraft to either the MIR or ISS space stations, due to technical irregularities, has been recurrently one of the most manually steered flight phases and has been proved as a challenging maneuver for the spacecraft's commander. In the early phases of manned spaceflight, space agencies mainly resorted to the use of the flight instructors' subjective rating during simulator or airplane training. Nowadays, highly parametrized trainings can be analysed with higher detail to assess flight performance.

Within the framework of the SIMSKILL Experiment, which aims to investigate the effects of confinement and hypoxia for long term space missions in the Antarctica research stations Halley VI and Concordia as well in Stuttgart, Germany, the Soyuz-TMA spaceflight Simulator developed by the University of Stuttgart offers the possibility of training the docking procedures undertaken by the astronauts in a high-fidelity simulation. Consequently, a flight evaluation methodology has been developed in order to analyse the flights performed by the participants in the simulator. The raw data obtained from the simulator (spacecraft speed, position, angles, joystick inputs i.a.) is processed by means of spacecraft dynamics and control algorithms and, subsequently, the flight performance can be assessed, providing a better insight on which are the critical parameters during each flight phase. With the use of statistical analysis, this evaluation method enhances the recognition of individual patterns, environmental influences such as isolation, hypoxia or lack of daylight, and weaknesses caused by different flight strategies undertaken by the pilots. This document describes the operating principles of the flight evaluation methodology, and gives a detailed description on the computational techniques used to process the flight data recorded from the experimental sessions undertaken both in Germany and the Antarctica.

The use of such feature on simulator training procedures is therefore an interesting implementation,

which offers additional feedback on flight performance besides personal advice from the instructors, enhancing the assessment of stressing mission phases.