

SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)  
TO BOLDLY GO - SPACE STATION EDUCATION AND OUTREACH (5)

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EDUCATIONAL TRAINING ON SPACECRAFT OPERATIONS IN A SOYUZ MOCK-UP  
SIMULATOR

**Abstract**

The Institute for Space System (IRS) at the University of Stuttgart is offering hands-on experience for students in the field of aerospace engineering with tutorial and training in a space flight simulator. In addition to the theoretical knowledge given in lectures the students can gain practical experience and develop a better understanding of spacecraft operations in a simulated space environment. Furthermore, the intrinsic motivation of students is activated by individual flight lessons in a mock-up model emulating a Soyuz-TMA spacecraft. The training comprises of theoretical lessons followed by intensive practical sessions guided by an instructor, supplemented with free training hours for each trainee. The candidates are introduced with basic manoeuvres at the beginning of the course up to complex mission scenarios toward the end of the course. The training performance of each candidate is monitored and evaluated to provide a progress feedback in a final debriefing session. The initial software, purchased from the Gagarin Cosmonaut Training Centre in 2007, was used for the training of rendezvous and docking operations between the Soyuz spacecraft and the International Space Station. Since then the simulator was increasingly upgraded with additional features like a scale replica of the Soyuz re-entry capsule, a functioning cockpit with two additional displays, a two-way radio, and a ground station. New simulation software was added in 2008 to expand the variety of scenarios and for the implementation of additional flexibility. The new software is based on the 2006 version of the "Orbiter Spaceflight Simulator" by Dr. Martin Schweiger and was modified and customized to support the simulation environment of the Soyuz-TMA at the IRS. Requirements for the software outlined a simulation architecture which modularizes and parallelizes tasks. These tasks are distributed among a network of computers exchanging data over an Ethernet/TCP protocol in near-realtime. All required software and hardware elements are developed accordingly, including a network based Multiple Function Display (MFD) facility for bridging instrumentation over ethernet, a 'Simserver' for system-level simulation and the spacecraft-specific instrumentation. As a Final step, the Russian Soyuz-style spaceship model is implemented together with distinguished parameters. In addition to the technical upgrades, the educational approach could also be enhanced according to the feedback given by the students and experts from the European Astronaut Centre (EAC) in Cologne. During the last three years over 70 students participated in the simulator training and accumulated over 1000 hours of flight time.