EADS SPACE TRANSPORTATION

News Release

German space robotic system for the International Space Station

- **Forward-pointing technology thanks to co-operation between research and industry**
- **ROKVISS to be tested on the ISS under real conditions**
- **Bremen-based EADS competence centre plays a leading role**

Bremen, December 2004 - Precise mechanical repair on Earth requires the highest possible degree of skill, co-ordination and dexterity and it is even more complicated to carry out such tasks in space. Bremen-based EADS SPACE Transportation is currently developing a robotic system which, remote-controlled from Earth, will be able to maintain satellites and add components thus saving the expense for posting an astronaut as mechanic. On 24 December 2004, ROKVISS (Robotik-Komponenten-Verifikation auf ISS - Robotic components verification on ISS)) will be launched onboard a Russian Progress capsule from Baikonur to the International Space Station, ISS. From the middle of January 2005, the robotic experiment will be mounted on a platform outside the ISS with testing under real conditions to start in March. The experiment is scheduled to run for a period of about one year.

New dimension in space robotics reached

ROKVISS is a robotic arm that has a length of about 50 centimetres and is equipped with two joints, a metal finger and two cameras. ROKVISS shall demonstrate that the robotic arm can be controlled from Earth with hardly any time delay. The automatic mode, which starts operation when there is no radio contact between the ground station and the ISS, will also be tested. Successful demonstration would lead to the fact that dangerous and

strenuous work in space usually executed by astronauts could be done by robotic arms in the future.

Indeed, the use of robotic systems is nothing new in precision mechanics. By developing a system for space applications, however, EADS SPACE Transportation, enters a new dimension. Particularly the use outside of space vehicles makes much greater demands on robotic systems than the work on Earth. On the one hand, the systems need to withstand extreme fluctuations in temperature and cosmic radiation, on the other hand they need to be very sensitive in their movements and in dosing their forces to ensure that the entire space vehicle system to which they are attached does not start to tumble. A complex system comprising mechanical, sensor, data transmission and data processing components is the pre-requisite of efficient use. After all, the practical helpers in orbit must allow manual operation from Earth over a distance of several thousand kilometres with hardly any time delay. At the same time, they also have to be able to automatically carry out complex tasks on the basis of intelligent information processing.

Manipulator mobility - modelled on the human arm

The mechanical components alone, which EADS SPACE Transportation and its partner from research and industry developed for the robotic system, represent a real technical challenge and show a wealth of technical innovation. The joints of the robotic arms, having an angle of traverse of almost 360 degrees, combine high processing precision and a fast reaction time: movements are made within milliseconds within the range of fractions of a millimetre and produce torques between 0.1 Nm and 40 Nm. Basic equipment of future systems will comprise at least six joints, providing the entire range of joint motion of the human arm. For complex applications, however, it is intended to use additional joints.

Owing to the fact that focus of the ROKVISS project is on the interplay of all the components, EADS SPACE Transportation restricts verification to the

use of two joints only. During the experiment, development engineers will particularly concentrate on the complex control systems. On future missions, the robotic arm shall be operated manually as well as automatically. To this end, intelligent software will process information on the position of both the manipulator and the object to be treated, and on the position of the individual joints which will be acquired by sensors, a stereo camera and later on by laser beam. The system is so sophisticated that the operator in the ground control centre does not only experience the movements in space visually on the screen but also haptically via the joystick. In order to make co-ordinated movements on Earth and in space in real-time, the signals from space must be transmitted within 500 milliseconds. Despite the great distance, signal transmit time is nearly the same as the time required for transmitting information from the brain to the hand.

Testing under real conditions indispensable

Owing to the fact that the complex interplay of all components and the time sequences required for data transmission and data processing can only be tested under real conditions, verification on the ISS is indispensable. Simulation on Earth, which indeed was very successful, could have been affected by false assumptions that could have unfortunate consequences under real conditions.

EADS SPACE Transportation in its function as "prime contractor" developed and built the hardware and software for ROKVISS. Under contract to Deutsches Zentrum für Luft- und Raumfahrt (DLR - German Aerospace Centre, Cologne) and under the leadership of EADS SPACE Transportation, the DLR Institute for Robotics and Mechatronics (Oberpfaffenhofen) will be responsible for the joints of the robotic system, experiment performance and scientific analysis of the results achieved. Kayser-Threde (Munich) developed and built the experiment computer and other electronic units while Hoerner & Sulger (Schwetzingen) supplied the camera equipment. Other important partners are the Russian Space Agency Roskosmos and the Russian

company RKK Energia (Koroljov near Moscow), who made it possible that the system can be mounted on to the Russian module of the ISS for testing.

Total cost of ROKVISS will cover an amount of EUR 11.5 million, including launch, installation and operation. The project will be financed by the Bundesministerium für Bildung und Forschung (BMBF - Federal Ministry of Education and Research).

On the way towards satellite maintenance

ROKVISS represents the preliminary stage of another experiment, preparation of which EADS SPACE Transportation has started already. On the next demonstration mission, TECSAS (TEChnology SAtellite for demonstration and verification of Space systems), the robotic system, which will be equipped with seven joints, camera, computer system and complete software, shall demonstrate its capacity of performing specific service tasks. Furthermore, the EADS engineers will also test a laser-based sensor system providing precise information about the spacial orientation of the object to be treated and thus the basis for a decision on definite working steps.

Successful verification of TECSAS would be the entry ticket for a technically as well as economically interesting market: satellite repair and upgrading. Today, artificial celestial bodies can be repaired or upgraded to a very limited extent only. Usually, such work can only be executed if the astronaut leaves his space vehicle at great expense or if the satellite is brought into the cargo bay of the Space Shuttle, for instance. The EADS SPACE Transportation development, however, allows unmanned technical missions and remote-controlled assembly from Earth. This is not only an interesting aspect when the repair of defective satellites is concerned. The attachment of new or additional modules is also possible. For example, telecommunication satellites could be upgraded at low cost and decisively improve in profitability thanks to their longer service life.

EADS SPACE Transportation is the European lead company for civil and military space transportation and manned spaceflight. EADS SPACE Transportation is a wholly owned subsidiary of EADS SPACE. In 2003, EADS SPACE achieved a turnover of EUR 2.4 billion with a labour force of 12,000 in France, Germany, Spain and the UK.

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