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Remote control in space – German robot arm on the ISS starts up routine operation

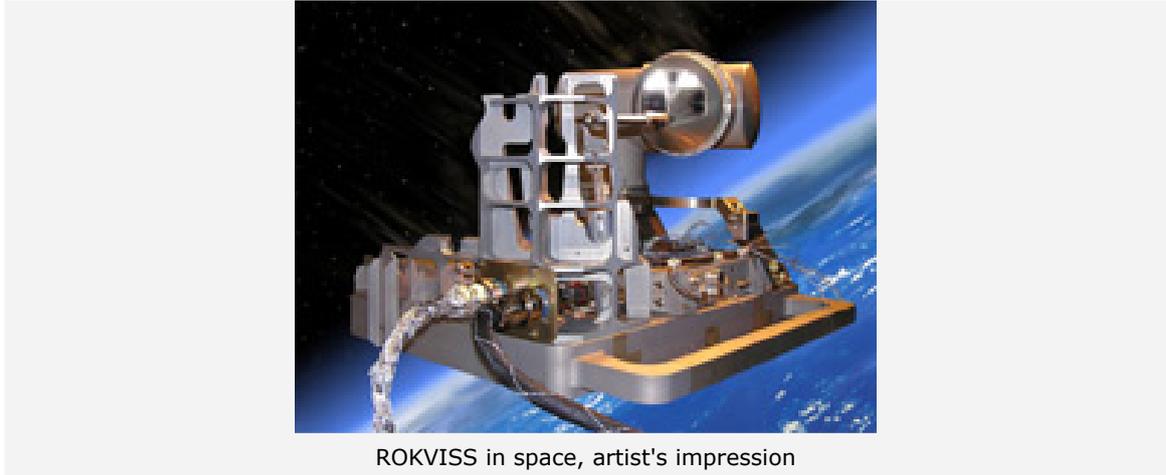
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Oberpfaffenhofen – The ROKVISS (RObotic Components Verification on the ISS) experiment developed by the German Aerospace Center (DLR) in Oberpfaffenhofen can now also be activated and moved through space from Earth. The key tests have been conducted from DLR's ground station in Weilheim, Upper Bavaria, in what is known as telepresence mode with force feedback during an approximate six-minute period when the ISS was flying over the station. These tests saw a robot being controlled from Earth with a short time delay – a world-first for space robotics.

The German ROKVISS robot arm had already passed all the tests in so-called automatic mode in March 2005. In this mode, sequences of movements which had been pre-programmed and transmitted to the ISS were automatically undertaken by the robot arm at a specified time. The tests have now also been run successfully in what is known as telepresence mode, proving that direct remote control of the robot arm from Earth and the force feedback function operate perfectly. The robot arm, fitted on an outer platform of the ISS, can therefore start its scheduled seven-year experimental phase in space undertaking tasks in all areas.

Direct remote control of robot arm in telepresence mode



When flying over the transmitting and receiving antenna in Weilheim (southern Germany) in telepresence mode, the robot is directly remotely controlled from Earth and undertakes movements in space with the shortest of time delays. The Earth-based scientists operating the robot arm in turn also receive visual and sensory feedback on the robot arm's actions with the shortest of time delays. This speed is achieved by the real-time transfer of stereo images coupled with the force feedback, also transmitted with an extremely short time delay of around 20 milliseconds, giving the Earth-based scientists direct sensory feedback (which can be felt on the control panel's joystick) about the levels of force produced in space. These arise, for example, when the robot arm in space sensitively scans the metallic contour fitted on the same outer platform.

Now that the robot arm has successfully completed all the scheduled tests, Professor Gerhard Hirzinger, Director of the DLR Institute of Robotics and Mechatronics in Oberpfaffenhofen, explains: "We have taken another giant step forwards in the development of new types of lightweight robots for cost-effective deployment in space and in easily and remotely operating them from Earth." He stressed: "By successfully completing all the robot arm tests, DLR has impressively confirmed its leading international position in the field of space robotics."

The robot arm fitted on the ISS is around 50 centimetres in size, weighs seven kilograms, has two hinges, one metal finger and two integrated cameras. It is based on DLR's state-of-the-art lightweight robot technology. In the future, it could play a key role in repair or assembly work in space. The ROKVISS experiment, planned and developed in Germany, aims to test and verify the new robot hardware and high-performance control concepts in a realistic mission simulation and in space. In the future, this innovative robot technology should assist and relieve the stress of astronauts undertaking complicated tasks. It could also allow satellite repair work to be controlled from Earth.

The German robot arm was transported to the ISS on 24 December 2004 by the Russian space station Baikonur using a Russian Soyuz U rocket. Two astronauts fitted it to the outside of the station on 26 January 2005 during a 'space walk' lasting around six hours.

Major project for German space industry and research institutes

The project is being financed by the German Aerospace Center (DLR) with funding from the German Ministry of Education and Research (BMBF). EADS Space Transportation in Bremen was the main contractor taking responsibility for system integration and for the key components of the on-board software. The DLR Institute of Robotics and Mechatronics in Oberpfaffenhofen developed and built the robotic components and is responsible for running experiments and for the scientific evaluation of results.

Kayser-Threde from Munich is assuming responsibility for the development and construction of the experiment's computer and power supply as well as providing the DLR institute with technical support. Hoerner & Sulger supplied the camera equipment and electronic accessories. Project management was handled by DLR's space agency. Implementation of this mission is based on an agreement between DLR's space agency, the Russian partner Roskosmos, RKK Energia and Munich-based Kayser-Threde, which is also acting as the main contractor for the S-band communication infrastructure.

The cost of the ROKVISS experiment runs to € 11.5 million, including € 3.5 million for launch, assembly and operations on the ISS, which Germany is paying the Russian contractual partner. .

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