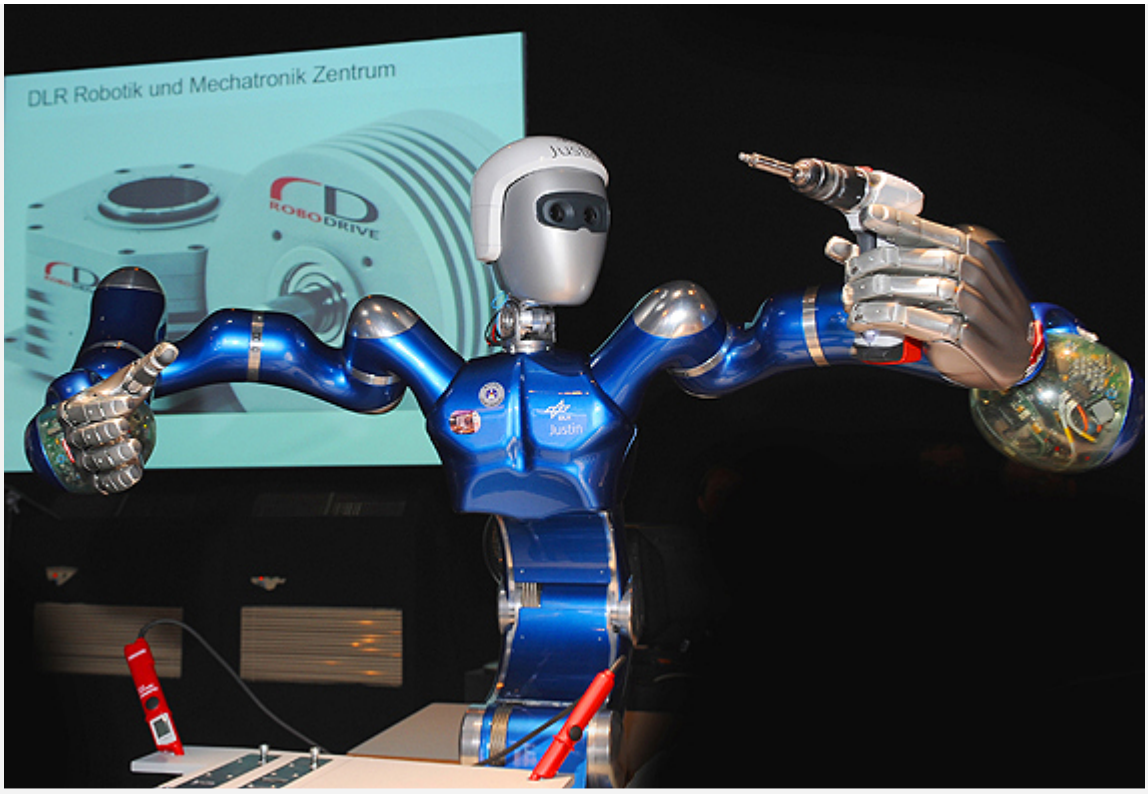
News Archive Space 2010

Outer space close enough to touch – DLR telepresence research

3 September 2010

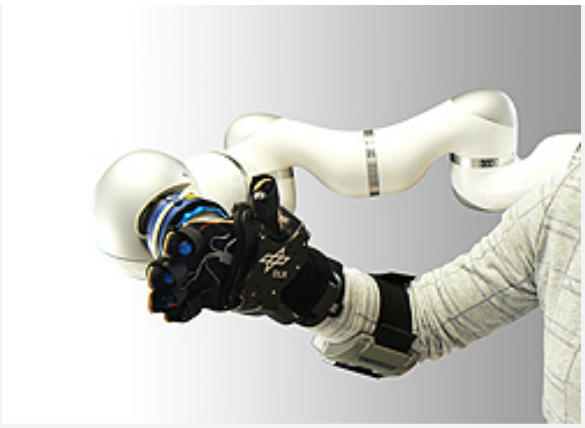


DLR's Space Justin is to be deployed in space as a service robot

Telerobots (remotely controlled robots) can be used not only in outer space but also in terrestrial environments that are hazardous for human beings, such as minefields or areas affected by nuclear radiation. Innovations derived from virtual reality telepresence and teleaction are also being employed in technology for medicine and production environments. The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) leads the world with its research into the field known as 'multimodal telepresence'. At the DLR Institute of Robotics and Mechatronics in Oberpfaffenhofen, an entire team of researchers is dedicated exclusively to this topic.

The DLR scientists reporting to project manager Carsten Preusche at the Institute of Robotics and Mechatronics have developed a human-system interface which provides a user-friendly and intuitive form of interaction – between the person as the controlling virtual operator and a robot acting as the physical teleoperator. The person involved is linked to the system in a multimodal manner and directs the arm, finger and head movements of the telerobot in real time. The special aspect here is that human sensory inputs are transmitted back to the operator. "The operator is able to see, hear and feel the environment and the interaction of the robot with that environment. This link, involving a range of human senses, enables the human operator to feel physically present in these remote environments. We describe this technology as 'multimodal telepresence'," explains Carsten Preusche.

Human and robot united



Data glove and arm sleeve with vibration feedback

The 'unification' of man and machine takes place in three stages. First of all, the operator slides an arm into an arm-length sleeve with vibration feedback and data gloves equipped with flexible sensors. At first glance, this sleeve resembles a thin leather glove. The operator then puts on the data goggles, in a manner similar to putting on a bicycle helmet. This head-mounted display delivers 3D imagery and records the head position in virtual space. Finally, the human operator is connected to the haptic (touch-sensitive) input station – comprising two DLR lightweight robot arms, used to control and depict forces.

"I stand, or sit down, between the input arms and slide my left and right hands into their holders. At these points of contact, I receive feedback about the various forces encountered – for example when I task the robot with the use of a battery-powered wrench, I physically sense the resistance level encountered," explains Simon Schätzle, a member of the Telepresence and Virtual Reality research group at the DLR Institute of Robotics and Mechatronics. A foot pedal on the floor provides the operator with an emergency stop switch. This is used to enable the system, and can shut it down again at any time.

Safety is a central concern in all matters relating to interaction between man and machine. To prevent physical injuries, a safety coupling releases the hand mounting on the device whenever forces rise above a defined level. In cases like this, the entire system is also shut down at the same time. "Dealing with telepresence technologies is therefore absolutely risk-free for human operators," emphasises project manager Preusche.

Surprisingly 'real'

Telepresence technologies enable people to experience remote or virtual spaces realistically and to alter them with the help of robotic systems. Although it is a highly complex matter to set up these various components properly and to make them interact, operation at the input station itself is a fairly simple matter. The robot arms provide one example of this – their freedom of movement equates to that of the human torso. This enables the operator to implement each work operation directly; that is, without any need for conversion, which means that the teleoperator can be operated intuitively. The human operator’s sense of touch is stimulated by a vibro-tactile interface – similar to that in a mobile phone when it 'confirms' actions by means of a slight vibration through the screen keyboard, thereby depicting such things as contacts at the elbow.

Human-System Interface: control station with 3D visualisation and finger-tracking to determine finger positions

DLR engineer Simon Schätzle knows from his own experience just how 'real' the virtual world can feel. During DLR's presence at the 2010 International Aerospace Exhibition (ILA) in Berlin, he demonstrated the potential applications of this system to visitors, and controlled the telerobot, Justin. "After about 25 minutes, when I handed over to my colleague, I was at first really irritated that I was left standing at the side of the trade fair stand – and not centre stage like the robot. I still had the feeling that I was Justin. That really was a strange feeling".

The future of space travel

Multimodal telepresence is viewed as a key technology for the future of space travel. An important area of application is that of on-orbit servicing. The aim here is to repair defective satellites up in space from down here on Earth, or to deliberately move them out of orbit for destruction during re-entry. The telepresence operations required to make this possible have already been put in place between the International Space Station (ISS) and the ground station in Oberpfaffenhofen. ROKVISS, a system used for verification of robot components, has been operating as a technology experiment on board the ISS since the end of 2004 and can now be controlled remotely from any point on Earth by a combination of laptop PC and mobile phone.

In future, intelligent robots are to be used in space as the 'extended arm of humankind'. That means that the deployment of DLR's robot Justin, built to resemble a human being, does not need to be restricted to planet Earth. As 'Space Justin', the service robot can operate in orbit – it receives movement commands from an operator down here on Earth. This means that the robot of the future will be able to carry out complex repair tasks and reduce the workload of astronauts during their difficult and dangerous space missions. Telepresence technology is the key to an optimum combination of the intellectual capabilities of human beings on Earth with the dexterity and precision of a robot in space.

Related Contacts

Bernadette Jung
German Aerospace Center
Corporate Communications, Oberpfaffenhofen
Tel: +49 8153 28-2251
Fax: +49 8153 28-1243
E-Mail: Bernadette.Jung@dlr.de

Contact details for image and video enquiries as well as information regarding DLR's terms of use can be found on the DLR portal imprint.