Robots that share their feelings

SOUTHEAST UNIVERSITY's work on human-robot interaction systems has potential for use in manufacturing, surgery, and rehabilitation, as well as in exploration of extreme environments.

Behind the robotic lunar rover in China's Chang'e-3 unmanned lunar exploration mission was remote control technology developed at Southeast University (SEU) in Nanjing.

Remotely operated robots perform tasks in dangerous or far-flung locations, such as the deep ocean or in space. For the human-robot communication needed for a teleoperation system to receive commands, sensory feedback, including kinesthetic sensations felt by the robot, must be fed back to the human operator. Through this interactive link, the human operator can accurately sense the robot's perception, feeling with his/her hand what the robot feels in real time, and controlling the robot's response.

The SEU team developed two sets of ground-based simulated teleoperation experiments for the Chang'e-3 rover, Yutu. Their work on teleoperation control and the perception system for environmental recognition ensured Yutu's successful information collection and the success of the unmanned lunar exploration mission.

Conventional force sensors can normally only measure force in one dimension. For better robotic control, SEU researchers, led by Song Aiguo, developed six-axis force sensors, making the robot more dexterous. As well as force, the robotic hand they created can sense shape and texture, and determine roughness and hardness, allowing recognition of different materials.

Tactile sensors and haptic actuators for measuring and controlling the forces exerted and felt by the robot are key to human-robot interactive teleoperation systems. This technology is a specialism of the Institute of Robotic Sensing and Control Technology, established at SEU's School of Instrument Science and Engineering in 1983.

Their efforts have led to innovative progress, including high-precision six-dimensional robotic force sensors, bionic flexible tactile sensors, miniaturized force feedback actuators, and other human-robot interactive teleoperation components.

These devices, as well as their teleoperation robotic systems have been integral to China's lunar exploration projects. Apart from the lunar rover for Chang'e-3, Song's team also developed an in-orbit force measuring device, which was used for a human-operator training programme, as well as for biomechanical measurement.

Other work by Song's team focuses on detecting neuro-electrical signals and stimulation for robotic control and sensing. "We want to achieve natural or intuitive human-robot interaction and integration," said Song.

The technology is also being applied to the development of myoelectric prosthetic control and rehabilitation robots, which could be used to help people with disabilities. ■

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Teleoperation robots designed by Song's team can be used for inspecting dangerous or inaccessible sites.


SEU researchers have developed dual-arm 6 DOF haptic device that allows force feedback to human operators.


The myoelectric prosthetic hand developed at SEU is dexterous, and can feel force.