Tele-operated vs 3D Laser Guided Robot Control

A comparison of conventional tele-operated robots to 3D laser guided robots is presented below. The following topic was shared in NSF's biennial survey for emerging frontiers:

Tele-operated Robots Introduction & Description

Tele-operated robots are similar to the exo-skeleton approach of medical robotics because they mimic or translate movement of human limbs to operate a robot remotely. All of the motions of the human, who is located at some distance away, are scaled to perform robot motions remotely.

The tele-operated system, **needs to transmit commands to each of the robot motors to mimic the movements of the human limb**. This communication of motor control information for all the motors creates delays (phase lag) in the operations of the teleoperated robot.

Watch Meet Taurus, the VR Controlled Bomb Disposal Robot | Wired Video | CNE | Wired.com

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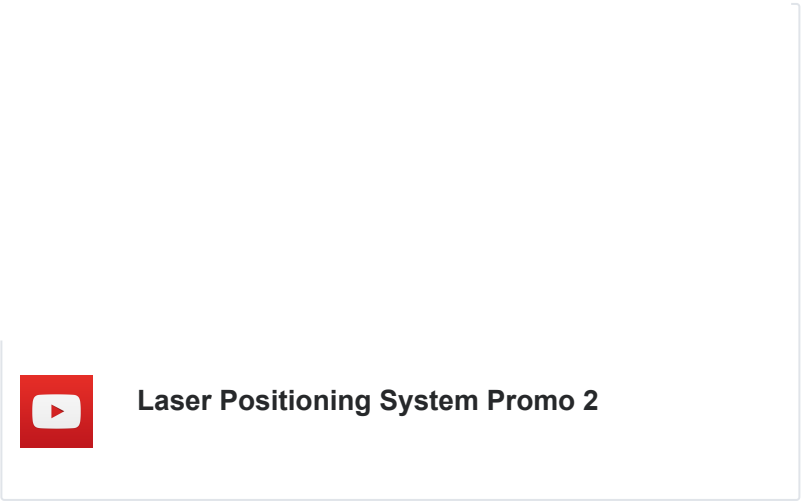
Condé Nast

This is Taurus, SRI’s tele-operated robot, which ventures where human beings dare not.

3D Laser Guided Robot Control Introduction and Description

A 3D laser positioning system is a laser distance meter that pans around and tilts up and down. The pan and tilt angles are measured with high resolution encoders. Thus, a 3D position can be measured using spherical coordinates: the radial distance of the laser distance meter and the pan, tilt angles of the encoders. **A 3D Laser distance meter guided robot system uses an inverse kinematics routine with a 6DOF robot model to move a jointed-robot arm like humans do with hand and eye coordination**.



The 3D laser positioning system approach differs from typical tele-operated robots . It **does not need to send the control signals for each of the joints to get to the pointed location of the laser beam**. Artificial intelligence in the form of a virtual robot limb is programmed into the robot operation system allows it to respond laser positioning commands without needing the remote transmission of joint angles and rates. It only needs the next local position provided by the laser. The local operating system figures how get to the pointed location. This feature allows near real time control even for applications on another planet.

For a remote application, only the laser is remotely controlled to position the distant robot arm to a desired location by pointing in its local environment. If the location is in free space in the remote location(e.g. the location is not a tangible object), robot will use an offset from the pointed location. The robot finds the same location using its calibrated coordinate system. The robot's coordinate system is easily related to the laser's coordinate system.

The calibrated robot coordinate system is defined using absolute accuracy robots. See this link for vendors that modify robot coordinate systems to give a repeatable position at the sub millimeter range.

[Robot Absolute Accuracy Calibration | Metrology Services | Creaform]

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Creaform

Creaform's onsite robot calibration service improves robot absolute accuracy up to 10x throughout the robot's wo...

3D Laser Guided Robot Control Advantage

The 3D laser positioning system, the robot has local control logic to follow the laser beam. It does not need to send the control signals for each of the joints to get to the pointed location of the laser beam. It only needs the next command to position the laser. This feature allows near real time control even for applications on another planet.

Engineering Opportunities

The 3D laser distance meter concept makes possible improvements in robotic control in a number of industries such as quadruped locomotion, tele-operated robots, medical robotics, 3D gaze tracking for artificial limbs design and control, real-time manufacturing robot positioning instead of drag, record and replay, remote painting, and remote landscaping etc.