Human-Like Bilateral Robotic Arm Controls for Remote Pipe Maintenance

Tianyu Zhou[1], Qi Zhu[2], Jing Du, Ph.D., M.ASCE[3*]

[1] Ph.D. Student, The Informatics, Cobots and Intelligent Construction (ICIC) Lab, Department of Civil and Coastal Engineering, University of Florida, FL 32611; email: zhoutianyu@ufl.edu
[2] Ph.D. Student, The Informatics, Cobots and Intelligent Construction (ICIC) Lab, Department of Civil and Coastal Engineering, University of Florida, FL 32611; email: qizhu@ufl.edu
[3] Associate Professor, The Informatics, Cobots and Intelligent Construction (ICIC) Lab, Department of Civil and Coastal Engineering, University of Florida, FL 32611; email: eric.du@essie.ufl.edu; Corresponding Author.

ABSTRACT

The use of robotics has demonstrated numerous advantages in civil engineering applications. Telerobotics is expected to play a key role in achieving a successful civil engineering project in humans' hard-to-reach environment, such as scenes of nuclear leakage and mining disasters. Due to the high accuracy and flexibility, the robotic arm has gained popularity in telerobotics. Most existing approaches have focused on teleoperate robotic arms based on the pose (position and orientation) of the end-effector, leading to the risk of the pose of other joints moving in undesired directions and cause collisions. This paper proposes an innovative control method that teleoperates the robotic arm based on the pose of the end-effector and another joint between the start joint and the end-effector. The Baxter robot (Rethink Robotics) was developed as the testbed to be controlled based on a VR controller (end-effector) and a VR tracker (middle joint) in a pipe skid maintenance task. The human operator held the VR controller in his hand, wore the VR tracker on his elbow joint, and operates Baxter to complete the task. The Inverse Kinematics (IK) was used to calculate the rotations of the rest of the joints based on the poses of the start joint, middle joint, and end-effector. The proposed method can control the robot to move according to the pose of the human arm and reduce the risk of collision.