

VR-based Haptic Simulator for Subsea Robot Teleoperations

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ABSTRACT

Subsea engineering operations heavily rely on remotely operated vehicles (ROV), and the performance depends on the seamless interaction between ROV and the human operator. Due to the dynamics of subsea environments such as the uncertainty of turbulence, affected visibility, and the interference with subsea ecosystems, control of subsea ROV is challenging for human operators who have never exposed to such an environment. Even with the tremendous amount of practice, the human operator can easily misjudge the situation and make wrong decisions in subsea operations. This research proposes an intuitive human-robot collaboration method based on mixed reality system (VR/AR). To explore the potentials of utilizing a mixed reality system to accomplish ROV control, a haptic suit is combined with VR goggles to bring an immersive subsea environment to the operator. A comprehensive physics model is first transferred to VR equipment, depicting a detailed underwater environment including turbulence and interaction with ambient objects. Then the haptic suit executes the corresponding pressure signals to the operator's body in real-time. The feedback signals from haptic suit provide the human operator with realistic sensation of subsea situations peripheral to the robot. This immersive virtual environment ensures ROV operators of real-time awareness of the proximity conditions and prediction of changes. As a result, a less-trained human operator can pilot the ROV based on his/her intuition and experience to maximize the performance and avoid potential mistakes.