

Virtual ACS 2021 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Research In-Progress

A Virtual Reality Consumer-level Haptic Epidural Simulator

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Introduction: Performing an epidural is a very complex and demanding task for an anesthetist to learn. Virtual reality (VR) and haptic simulators have the potential to provide cost-effective learning opportunities to improve epidural expertise, increase patient safety, and success rates. Here, we present the *Unity Simulator for Epidural Insertion Training (USEIT)*, a VR-based haptic-enabled system for epidural training. USEIT implements a novel model that integrates a haptics library with VR visual feedback, and drug administration through an open electronics' controlled valve. The system employs off-the-shelf materials, 3D printed parts and the freely available Unity game engine.

Methods: The user manipulates a Tuohy needle attached to a 3D printed end-effector that is in turn attached to a consumer-level haptic device (Novint Falcon). Upon locating the point of insertion and penetrating the virtual patient's skin, the movement of the needle is locked perpendicular to its shaft axis by force feedback. If the insertion is poorly executed and the needle hits the backbone, the user is alerted via vibration. The system models the associated needle forces by simulating soft tissues utilizing a unique "mobile nonlinear spring" model. A syringe is attached to the Touhy needle, and a loss-of-resistance method is applied using an Arduino-controlled fluid-valve system that includes water/saline filled syringe simulating flow resistance to the drug administration (see Figure 1). The user can be provided a visual feedback of the patient's back on a 2D display or with a stereoscopic 3D view using a head-mounted display.

Preliminary Results: No results available yet.

Next Steps: Technical report describing the system is in preparation. The next steps include examination of a) system usability, b) face, content and construct validity, c) efficacy and d) effectiveness. Concurrently, we plan to assess readiness for implementation, construct and study an implementation process using Consolidate Framework for Implementation Research.

