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Engineer developing haptic feedback system for med students

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This could be the best and most realistic version of "Operation" ever, but a system under development at Rice University to help train doctors is no game.

The National Science Foundation has awarded a $1 million, three-year National Robotics Initiative grant to Rice mechanical engineer Marcia O'Malley to create a haptic cueing system that will vibrate, rather than buzz, medical students to enhance their training as they learn to perform endovascular surgeries.

O'Malley, an expert in haptics and robotics for rehabilitation, said the system will combine virtual reality with touch feedback that could ease the process of learning how to perform such surgeries for doctors – and ultimately ease the surgeries for patients.

The system will track trajectories of the tool tip as it is inserted by the student into the vascular system of a real or virtual mannequin patient. A gentle vibration will give immediate feedback to the student regarding the quality and smoothness of the tool movements through the patient's vessels.

O'Malley is collaborating with surgeons at Houston Methodist Hospital and Rice psychologist Michael Byrne, who studies human-computer interactions.

"Endovascular procedures are minimally invasive procedures in which

you access the vasculature – the aorta, the renal arteries, the heart – typically through an incision in the femoral artery," O'Malley said. "Flexible guidewires and catheters are fed up the blood vessels to access the point of interest, where you're going to do a procedure like applying a stent.

"It's kind of like feeding a string through a straw," she said.

Doctors currently depend on live X-rays in a process called fluoroscopy that provide a 2-D view of the tools and a contrast agent in the bloodstream to guide them. "The training and assessment is, to date, quite subjective," she said. "They rely heavily on this philosophy of 'see one, do one, teach one.'

"The assessments would typically be done by an expert, a surgeon, standing over a resident watching them and saying, 'That looks good.' They might measure outcomes, like total procedure time, how much contrast agent they used or how much fluoroscopy time."

O'Malley and her team hope to tell surgeons how smooth their movements are through real-time feedback.

"In prior work, we showed we can correlate surgeons' expertise with the smoothness of the tool-tip movements," O'Malley said. "That pilot work led to this proposal to track the movement of the tools and turn that into a kind of feedback to the surgeon.

"We will compute smoothness from velocity profiles of the tool tips and encode that in a haptic cue, a vibrotactile feedback on the arm, kind of like your cellphone vibrating. We want that cue to capture that performance as measured by the smoothness metric."

The first task will be to figure out what cues provide intuitive feedback.

"We're going to take those cues and use them with domain experts doing navigational tasks on a virtual reality simulator and on a robotic endovascular platform," she said. "We want to see if, provided with this information, these change a doctor's strategy or performance.

"We're not trying to tell them where to navigate, but rather provide objective feedback on the quality of their navigation," O'Malley said. "Ultimately we want to improve training efficiency and effectiveness."

Provided by Rice University

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