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Colloquium
Cognitive Systems

Prof. Dr. Katherine J. Kuchenbecker, Max Planck Institute for Intelligent Systems Stuttgart

Tactile Reality

Touching an object causes rich haptic signals (both tactile sensations in your skin and kinesthetic cues from your muscles and joints) that enable you to quickly understand the object's physical properties and adeptly control the interaction. Although human experience centers on physical contact with tangible items, very few computer interfaces provide the user with high-fidelity touch feedback, limiting their intuitiveness. By way of three examples, this talk will demonstrate that well-designed haptic feedback can greatly increase the realism of virtual worlds. First, we created a simple visuo-audio-tactile simulator to help dental students learn to discriminate between healthy and decayed tooth tissue. The user watches a video of a real dental tool interacting with a tooth while simultaneously feeling an authentic rendering of the high frequency contact vibrations that occurred. Second, we created the world's most realistic haptic virtual surfaces by recording and modeling what a user feels when touching 100 real objects with an instrumented stylus. The perceptual effects of displaying the resulting data-driven friction forces, tapping transients, and texture vibrations were quantified by having users compare the original surfaces to their virtual versions. Third, we extended the haptic texture concept to capture how a real robot vibrates as it moves its joints and tied this model to measured user motions. The resulting vibrotactile experiences were formally evaluated and then added to an immersive game that lets the user feel what it would be like to turn into a robot. While much work remains to be done, we are starting to see the tantalizing potential of systems that leverage tactile cues to allow a user to interact with virtual environments as though they were real.

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Katherine J. Kuchenbecker directs the new Haptic Intelligence Department at the Max Planck Institute for Intelligent Systems in Stuttgart, Germany. She was previously an Associate Professor of Mechanical Engineering and Applied Mechanics at the University of Pennsylvania, where she held the Class of 1940 Bicentennial Endowed Term Chair and a secondary appointment in Computer and Information Science. Kuchenbecker earned her Ph.D. in Mechanical Engineering at Stanford University in 2006 and did a postdoctoral fellowship at the Johns Hopkins University. Her research centers on haptic interfaces, which enable a user to touch virtual and distant objects as though they were real and within reach, as well as haptic sensing systems, which allow robots to physically interact with objects and people. She delivered a TEDYouth talk on haptics in 2012, and she has received several honors including a 2009 NSF CAREER Award, the 2012 IEEE Robotics and Automation Society Academic Early Career Award, a 2014 Penn Lindback Award for Distinguished Teaching, as well as various best paper and best demonstration awards.

Local host: Prof. Dr. Marc Ernst

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