IEEE SMC Distinguished Lecture

Emerging haptically-enabled systems for immersive simulation-based training: Design, Development, and Deployment

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Swinburne University of Technology

DATE:	Tuesday, 29 August 2023
TIME:	12:00pm – 1:00pm (Perth Local time GMT+8 hrs)
VENUE:	Murdoch University, 360.1.010 See https://maps.murdoch.edu.au/?sharepoi=136011.010 If you want to join Online – email to k.wong@murdoch.edu.au for the link
COST:	Free (IEEE and Non-IEEE members)
RSVP:	Email k.wong@murdoch.edu.au

****This seminar is co-organised by IEEE Systems, Man, and Cybernetics Society Western Australia Chapter, and Murdoch University School of Information Technology****

Abstract:
Simulation-based training (SBT) is on the cusp of offering a cost-effective regime for administering realistic and safe training in a virtual environment across a wide range of sectors. In SBT, the immersion factor is of prime concern to ensure efficacy of skill learning. Nowadays, emerging technologies, including virtual/mixed reality (VR/MR) and artificial intelligence (AI), have dramatically improved the immersive quality of SBT tools, providing AI-based smart interfaces with high-fidelity 3D visual and auditory experiences to users (trainees). While VR/MR systems offer effective visual cues, they often are unable to provide realistic tactile sensation when interacting with virtual objects for performing dexterous tasks in SBT.

This lecture will explicate the integration of haptic (force feedback) technology into VR/MR systems to increase their fidelity for SBT. Through this innovation, a user is able to "touch-and-feel" virtual and/or remote objects, and perceive their attributes via haptically-enabled VR/MR systems. As such, the user can feel the object properties, such as texture or hardness/softness characteristics, when utilising these haptically-enabled SBT tools in an immersive environment for skill acquisition.

This lecture will focus on the design and development of a series of haptically-enabled systems, particularly haptically-enabled motion simulators, firefighting trainers, and tele-healthcare robotic systems, for SBT purposes. Serving as a flight/vehicle simulator, the developed robotic-based platform is integrated with haptically-enabled peripherals, such as haptic chairs and haptic control devices, to offer a high-fidelity training environment. The user can enjoy realistic flying/driving experiences, e.g., air turbulence or rough terrain, during training. On the other hand, the haptically-enabled hot-fire trainers enable the user to experience realistic jet reaction forces from the hose and provides immersive water dispersion and interaction with fire and smoke particles based on accurate physics modelling via the VR/MR-based tools. In addition, a haptically-enabled ultrasound scanning system for tele-healthcare applications will also be exemplified. It allows the user (sonographer) to remotely "touch-and-feel" the anatomical structure of a patient during tele-scanning, allowing accurate diagnosis of patients in tele-health services.

A series of demonstration of these haptically-enabled systems will be presented during the lecture. Successful deployment of several developed systems in real-world environments through start-up companies will be illustrated. The impact of these emerging haptically-enabled system to realise the next generation of SBT tools for immersive and personalized training in various sectors, including aviation, automotive, healthcare and emergency services, will be discussed.

About the IEEE SMC Distinguished Lecturer

Distinguished Professor Saeid Nahavandi is currently Swinburne University of Technology's inaugural Associate Deputy Vice-Chancellor Research and Chief of Defence Innovation. He previously served as Pro Vice-Chancellor (Defence Technologies) and Founding Director of the Institute for Intelligent Systems Research and Innovation, Deakin University.

Saeid Nahavandi received a Ph.D. from Durham University, U.K. in 1991. His research interests include autonomous systems, modeling of complex systems, robotics and haptics. He has published over 1000 scientific papers in various international journals and conferences. Saeid was the recipient of the Clunies Ross Entrepreneur of the Year Award 2022 from the Australian Academy of Technological Sciences & Engineering, Researcher of the Year for Australian Space Awards 2021, Australian Defence Industry Awards - Winner of Innovator of the year, The Essington Lewis Awards, and Australian Engineering Excellence Awards - Professional Engineer of the Year.

Saeid has carried out industry based research with several major international companies such as Airbus, Boeing, Bosch, Ford Motor Company, General Motors, General Dynamics, Holden, Lockheed Martin, Nissan, Thales and Vestas just to name a few.

Professor Nahavandi holds six patents, two of which have resulted in two very successful start-ups (Universal Motion Simulator Pty Ltd and FLAIM Systems Pty Ltd). Professor Nahavandi is the Vice President: Human-Machine Systems, IEEE SMCS, Senior Associate Editor: IEEE Systems Journal, Associate Editor of IEEE Transactions on Cybernetics and IEEE Press Editorial Board member.

Professor Nahavandi is a Fellow of IEEE (FIEEE), Engineers Australia (FIEAust), the Institution of Engineering and Technology (FIET). Saeid is a Fellow of the Australian Academy of Technology and Engineering (ATSE). Saeid was the General Chair for IEEE SMC 2021.