



Human-Robot Interaction and Human-Robot Teams

*Prof. Dr. Vladimir Lumelsky, University of Wisconsin-Madison
IEEE Sensors Council Distinguished Lecturer*

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Abstract

The ability by a robot to operate in an uncertain environment, such as near humans or far away under human control, potentially opens a myriad uses. Examples include robots preparing the Mars surface for human arrival; robots for assembly of large space telescopes; robot helpers for the elderly; robotic search and disposal of war mines. So far advances in this area have been coming slowly, with a focus on specific tasks rather than a universal ability typical in nature. Challenges appear both on the robotics side and on human side: robots have hard time adjusting to an unstructured environment, whereas human cognition has serious limits in adjusting to robots and grasping complex 2D and 3D motion tasks. As a result, applications where robots operate near humans – or far away under their control – are exceedingly rare. The way out of this impasse is to supply the robot with a whole-body sensing - an ability to sense surrounding objects at the robot's whole body - and algorithms capable of utilizing these data in real time. This calls for large-area flexible sensing arrays - sensitive skin covering the whole robot body akin to the skin covering the human body. Whole-body sensing brings interesting, even unexpected, properties: powerful robots become inherently safe; human operators can move them fast, with “natural” speeds; robot motion strategies exceed human spatial reasoning skills; it becomes realistic to utilize natural synergy of human-robot teams and allow a mix of supervised and unsupervised robot operation. We will review the cognitive science, mathematical, algorithmic, and hardware (materials, electronics) issues involved in realizing such systems.

Biography

Vladimir Lumelsky is Professor Emeritus at the University of Wisconsin-Madison. His Ph.D. in Applied Mathematics is from the Institute of Control Sciences, Russian National Academy of Sciences, Moscow. He has held engineering, research, administrative, and faculty positions with Ford Motor Research Labs, General Electric Research Center, Yale University, University of Wisconsin-Madison, University of Maryland, NASA-Goddard Space Center, National Science Foundation. Concurrently he held visiting positions with the Tokyo Institute of Science, Japan; Weizmann Institute, Israel; USA-Antarctica South Pole Station.

Dr. Lumelsky has served as IEEE Sensors Council President; Founding Editor-in-Chief of IEEE Sensors Journal; Book Series Senior Editor for IEEE Press-Wiley Publisher; chair and co-chair of major conferences; on Editorial Boards of IEEE Transactions on Robotics and Automation and other journals; on governing committees of IEEE; as guest editor for special journal issues. He has authored over 200 publications (books, journal papers, conferences, reports); is IEEE Life Fellow, and member of ACM and SME.