PLENARY TALK

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The Future of Human–Robot Collaboration

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Abstract: Human-centered robotics seeks to extend human skills, intuition, and decision-making into dangerous, remote, and inaccessible environments, and not to replace them. This vision is exemplified by OceanOneK, Stanford University's humanoid underwater robot, which combines autonomous physical interaction capabilities with intuitive haptic and stereo-vision interfaces. Through this integration, human experts can perceive, manipulate, and interact with remote environments as if physically present. OceanOneK employs compliant control, whole-body interaction, and skill learning from human demonstrations to perform delicate manipulation tasks in complex underwater settings. During archaeological expeditions in the Mediterranean Sea, the robot enabled experts to explore fragile historical sites and interact with submerged artifacts at depths beyond normal human reach. These missions demonstrated the powerful synergy between robotic autonomy and human expertise. The talk will also present Stanford's OpenSAI framework, built around Simulation and Active Interfaces. OpenSAI provides an integrated environment for modeling, simulation, control, and interactive operation of robotic systems, supporting whole-body control, haptic interaction, and human-in-the-loop operation. It serves as a bridge between simulation, real-time control, and remote embodied interaction, enabling the development and validation of systems such as OceanOneK. Beyond underwater exploration, these technologies have broad application in resource discovery, remote healthcare, infrastructure construction and maintenance, disaster response, and space operations. Human-centered robotic systems can expand human presence and capability in environments that are hazardous or otherwise inaccessible. This plenary will present the scientific foundations, technological advances, and future directions of human-centered robotics, illustrating how OceanOneK, haptic interfaces, skill learning, compliant control, and OpenSAI can extend human reach and preserve human expertise while opening new frontiers for science, industry, and society.

Biography:

Oussama Khatib received his PhD from Sup'Aero, Toulouse, France, in 1980. He is Professor of Computer Science and Director of the Robotics Laboratory at Stanford University. His research focuses on methodologies and technologies in human-centered robotics, haptic interactions, artificial intelligence, human motion synthesis and animation. He is President of the International Foundation of Robotics Research (IFRR) and a Fellow of the Institute of Electrical and Electronic Engineers (IEEE). He is Editor of the Springer Tracts in Advanced Robotics (STAR) series, and the Springer Handbook of Robotics, awarded the American Publishers Award for Excellence in Physical Sciences and Mathematics. He is recipient of the IEEE Robotics and Automation (IEEE/RAS) Pioneering Award (for his fundamental contributions in robotics research, visionary leadership and life-long commitment to the field), the IEEE/RAS George Saridis Leadership Award, the Distinguished Service Award, the Japan Robot Association (JARA) Award, the Rudolf Kalman Award, and the IEEE Technical Field Award. Professor Khatib is a member of the National Academy of Engineering.