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Editorial : Special Section on ASME IMECE ARDC 2006 Machines for Human Assistance and Augmentation

Sunil Agrawal, Venkat Krovi and Marcia O'Malley
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Editorial

Special Section on ASME IMECE ARDC 2006 Machines for Human Assistance and Augmentation

This special section contains a selection of important research developments presented as part of the Symposium on Advances in Robot Design and Control (ARDC) at the ASME's annual International Mechanical Engineering Congress and Exposition, held in Chicago, IL, 5–10 November 2006. The central theme of the 2006 ARDC, "Performance Augmentation in Man-Machine Systems", was intended to bring together researchers to present novel developments in high-performance robotic systems and subsystems. The scope includes: (i) performance enhancement of man-machine systems; (ii) improvement of the control and autonomy of humans in complex functional tasks; and (iii) synergetic performance enhancements in diverse applications. In particular, we invited submissions that present rigorous theoretical and experimental examination of novel paradigms such as biomimesis for achieving the performance augmentation.

In this special section, three papers from the 2006 ARDC are presented which highlight the particular challenges of physical human-robot interaction for performance augmentation. The topics include the design, control and performance of an upper-extremity rehabilitation robot, a user-centered approach to bilateral teleoperation under large communication delays, and the design and control of a transfemoral prosthesis with powered knee and ankle joints.

Gupta et al. present the design, control and performance evaluation of a high-fidelity lower arm exoskeleton called the *RiceWrist*, which exploits the structural rigidity of a novel mechanical linkage to target applications of motor skill training and rehabilitation in stroke patients. The authors present the adaptation of haptic interaction algorithms that take advantage of this structural rigidity to provide a means for high-bandwidth yet stable rendering of high-force physical interactions with virtual objects.

Mitra and Niemeyer present a user-centered approach to bilateral teleoperation with significant communication delays by assuming a slowly or infrequently changing environment. Their model-mediated method abstracts the data to form a simplified model of the remote environment. The simplified model is ported to the master manipulator and is rendered locally to the user without lag. The slave manipulator is constrained to only execute force and motion commands consistent with the model. The authors present experimental results that highlight the system's behavior as it adjusts to unexpected environment interactions and as the model is updated.

Sup, Bohara and Goldfarb describe the design and control of a transfemoral prosthesis with powered knee and ankle joints. Specifics of the design, including kinematic optimization and the development of a three-axis socket load cell that measures forces and moments at the interface of the prosthesis and human are detailed. Finally, a gait controller aimed at coordinating user and prosthesis motion during level walking is presented and implemented on the hardware prototype.

We hope readers will find this Special Section on Machines for Human Assistance and Augmentation interesting and informative. As our editorial work comes to an end, we would like to express our deep appreciation to all of the authors and reviewers who supported this Special Section by contributing papers. We are grateful to all of the reviewers for their service and commitment to the journal through rigorous reviews, timely response to the tight schedule and, above all, insightful and constructive comments that helped shape the final outcome of this Special Section. Last but not least, our sincere appreciation goes to the current Editor-in-Chief Professor John Hollerbach and Associate Editor Antonio Bicchi for their vision, support and valuable advice throughout this process.

Guest Editors:

Sunil Agrawal, University of Delaware, USA
Venkat Krovi, State University of New York at Buffalo, USA
Marcia O'Malley, Rice University, USA