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Guest Editorial

Special Issue on Novel Robotics and Control

This special issue focuses on the following topic areas: (i) Biomimetics and locomotion, (ii) mobile vehicles, (iii) human-robot systems and haptic interfaces, and (iv) novel systems modeling and analysis. We believe that this special issue provides a compilation of the most recent developments in the field of robotics and will be an important source of information for current and future researchers.

Biomimetic Robotic Locomotion Systems: The performance benefits, in terms of robustness, stability, and energy efficiency, seen in biological locomotion systems have inspired four of the selected papers. Two papers address issues pertaining to biomimetic locomotion in liquid environments. In "Design of Machines With Compliant Bodies for Biomimetic Locomotion in Liquid Environments," Valdivia and Youcef-Toumi discuss the realization and performance evaluation of carangiform locomotion realized by a fish robot with an inherently compliant structural body design. The other paper by Behkam and Sitti evaluates the viability of a radically different flagellar motility scheme, typically seen in cellular-scale microorganisms, for realizing energy-efficient locomotion in swimming microrobots. Two other papers—"The Berkeley Lower Extremity Exoskeleton" by Kazerooni, and "The Effect of Leg Specialization in a Biomimetic Hexapedal Running Robot" by Clark and Cutkosky—explore biomimesis for enhanced legged locomotion. Clark and Cutkosky investigate the effects of heterogeneity and configuration selection of various compliant leg designs. Kazerooni examines the design and realization of a functional energy-autonomous leg-exoskeleton to enhance payload-carrying capacity of walking humans.

Mobile Vehicles: Key issues pertaining to design, modeling, and control of individual and groups of wheeled mobile locomotion systems are addressed in this set of four papers. Two of these papers address enhancing the capabilities for irregular terrain locomotion by wheeled vehicle either by careful design and parameter selection or by developing approaches for online terrain characterization. In "Kinetostatic Design Considerations for an Articulated Leg-Wheel Locomotion System," Jun et al. present methods for systematically designing candidate leg-wheel subsystems of actively-articulated wheeled vehicles. In "Visual and Tactile-based Terrain Analysis Using a Cylindrical Shaped Mobile Robot," Reina et al. propose and validate a novel terrain deformation-characterization method based on multiple internal sensor measurements. The other two papers address controller limitations directly at the modeling stage for real world applications. In "Control of Platoons of Nonholonomic Vehicles Using Redundant Manipulator Analogs," Bishop presents an adaptation of redundancy resolution techniques to facilitate coordination of platoons of mobile robots. In "Band-limited Trajectory Planning and Tracking for Certain Dynamically Stabilized Mobile Systems," Pathak and Agrawal provide explicit guarantees on trajectory-tracking performance for dynamically-stabilized robots by developing a formulation for trajectory planning that takes into account the band-limitations on control inputs.

Human-Robot Systems and Haptic Interfaces: The selected papers that address human-robot systems, specifically haptic interfaces and teleoperation, share a common theme in that each work aims to improve human performance or perception of a remote or virtual environment by incorporating improved actuation or control methodologies. Two papers specifically address bilateral teleoperation environments. In the first paper, "Internet-Based Bilateral Teleoperation," Ching and Book utilize wave variables to guarantee teleoperation stability under varying transmission delay, and improve performance. Second, Abbott and Okamura consider telemanipulation with forbidden-region virtual fixtures, in their paper entitled "Design of Stable Forbidden-Region Virtual Fixtures for Bilateral Telemanipulation." The remaining four papers in this section address the specific case of human user interaction with virtual environments and haptic feedback. In "Controlling the Apparent Inertia of Passive Human-Interactive Robots," Worsnopp et al. focus on collaborative haptic devices (cobots), and address the apparent inertia of a device as seen by the user. In "Haptic Manipulation of Serial-Chain Virtual Mechanisms," Constantinescu et al. present an approach that provides realistic haptic feedback when manipulating serial-chain virtual mechanisms by penalizing user motion based on the mechanism joint constraints. In "Model-Based Cancellation of Biodynamic Feed Through Using a Force-Reflecting Joystick," Gillespie and Sovenyi propose a model-based controller that cancels the effects of biodynamic feed through that produce unintended forces on a manual control interface. In "Shared Control in Haptic Systems for Performance Enhancement and Training," O'Malley et al. present a shared control architecture for haptic interfaces where the haptic device provides both force feedback according to the dynamics of the virtual system, and provides a control force at the user interface to assist in performance of dynamic manual tasks. Finally, inspired by the task-dependent regulation of elastic properties evidenced in human manipulation tasks, "Torque-dependent Compliance Control in the Joint Space for Robot-Mediated Motor Therapy" by Formica et al. presents an approach for similar mediation of the interaction control in rehabilitation therapy machines to enhance safety.

Novel System Modeling and Analysis: The selected papers on this topic focus on novel methods and their applications to robotic systems. In the paper "A Unified Controller for a Proportional-Injector Direct-Inject Monopropellant-Powered Actuator," Fite et al. describe the modeling and control of a proportional-injector direct-injection monopropellant-powered actuator for use in power-autonomous human-scale mobile robots. Krishnaswamy et al. describe and experimentally demonstrate a teleoperation control algorithm that renders a hydraulic backhoe/force feedback joystick system as a two-port, coordinated, passive machine in their paper "Bond Graph Based Approach to Passive Teleoperation of a Hydraulic Backhoe." Papadopoulos et al. describe a novel microrobotic platform that is able to perform translational and rotational sliding with sub-micrometer positioning accuracy using vibration micromotors in their paper entitled "Dynamics, Design, and Simulation of a Novel Micro-robotic Platform Em-

ploying Vibration Micro-actuators." Clapa et al. discuss programmable mechanical compliance (PMC) for human interaction tasks in their paper entitled "Programmable Compliance and Equilibrium Point Control of a 2 DOF Manipulator." In the paper "Control of Closed Kinematic Chains Using a Singularity Perturbed Dynamic Model," Wang et al. propose a new method in the control of closed kinematic chains (CKC), based on a singularly perturbed model.

We hope readers will find this *Special Issue on Novel Robotics and Control* interesting and informative. As our editorial work comes to an end, we would like to express our deep appreciation to all the authors and reviewers who supported this Special Issue by contributing papers. We are grateful to all 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 Issue. Last but not least, our sincere appreciation goes to the current Editor-in-Chief, Professor Suhada Jarasuriya, for his vision, support, and valuable advice throughout this process.

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