

Guest Editorial

THE need for high-performance robotic systems working in diverse environments and performing complex tasks continues to intrigue the research community. To push the performance of such systems, researchers develop advanced and complex models, simulate system behavior, and design novel control algorithms that target particular system behaviors or limitations. The techniques used are not only useful in improving advanced robotic systems, but also they are applicable to a large variety of complex mechatronic systems and therefore are of particular interest to the readers of the IEEE/ASME TRANSACTIONS ON MECHATRONICS. It is our expectation and goal that this focused section will succeed in invigorating research interests in both the traditional and emerging areas of robot dynamics and control.

This focused section contains 15 papers (10 regular and 5 short papers) that describe current advances in robot dynamics and control. The first three papers study the dynamics and control of manipulator systems. The first paper synthesizes a feedback signal that excludes high-order dynamics employing a band-limited state observer with a low-pass filter corrector. The method is demonstrated experimentally on a direct-drive robotic manipulator used in semiconductor manufacturing. The second paper studies the dynamics of parallel robots and mechanisms using differential variational principles of constrained dynamic systems, and discusses simulation issues related to such systems. The third paper focuses on the dynamics and control of a heavy-duty electrohydraulic harvester manipulator. Models for the rigid body and actuation dynamics are developed and parameters are experimentally identified and validated, leading to the development of a Cartesian controller exhibiting very good tracking behavior.

The next four papers address the modeling, analysis, and control of mobile robots. The fourth paper presents a new generation of compliant multi degree-of-freedom microconveyors that use direct drive standing wave ultrasonic actuators. The fifth paper describes new results on full-state tracking and internal dynamics of a nonholonomic wheeled mobile robots. The presented formulation offers new insight to the zero dynamics of the mobile robot. The sixth paper presents a new method for dynamic parameter estimation of mobile manipulators. The method optimally selects external excitation required by the dynamic system parameter identification method. The seventh paper proposes a hybrid system approach for fault adaptive

control of mobile robots. It integrates fault detection, isolation and control accommodation for trajectory tracking tasks.

Sensors and actuators are an important component of the control of robotic and mechatronic systems. We included three papers in this area. Mathematical models for spherical motion encoders are presented in the eighth paper. The control of ionic polymer metal composite actuators is investigated in the ninth paper. The tenth paper describes the design and control of a liquid monopropellant actuation system appropriate for the position or force controlled human-scale robots.

We have also included five short papers that study important problems on the dynamics and control of various manipulator systems. A dynamic model for the Tricept hybrid industrial robot is presented in the eleventh paper and is used for simulation and control purposes. The macro/micro control problem in the presence of macro flexibilities is addressed in the twelfth paper. The thirteenth paper focuses on manipulator interactions with a stiff environment, and develops a nonlinear bang-bang impact controller with gains and structure independent of the mode of operation. The problem of providing accurate parameter estimates for computed-torque control methods, using a neural network, fuzzy logic and a simple proportional-derivative controller is studied in the fourteenth paper. Stable grasping in rolling manipulations with soft deformable fingertips is addressed in the fifteenth paper.

We are grateful to all authors who submitted their papers for publication in this Focused Section. We would also like to acknowledge the tremendous efforts of the reviewers to complete this task on time. Finally, we would like to thank the past Editor-In-Chief, Prof. Toshio Fukuda, and the current Editor-In-Chief, Prof. Ren Luo, for their enthusiastic support for this Focused Section.

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