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Introduction to the special issue: telerobotics & mobile robots for space applications

Mohammad Jamshidi (Guest Editor)

CAD Laboratory for Intelligent & Robotic Systems, Department of Electrical and Computer Engineering, University of New Mexico, Albuquerque NM87131 (USA)

Robotics and telerobotics have always been and will remain as two of the most challenging multi-disciplinary areas of research and development among engineers. The global competition for quality products on one hand, and economic growth of nations on the other, as well as exploration of unstructured and extraterrestrial places, have all helped put robotics at the forefront of all major research and development organizations. New approaches of intelligent robotics and automation economic gains and a competitive edge to any major corporation who is competing in a global market place.

The object of this issue of *Robotica* is to present some of the latest issues facing robotic engineers who need to control and/or deal with telerobotics and mobile robots, both on earth and in space. Some of these papers were presented at the Fourth International Symposium on Robotics and Manufacturing – ISRAM which was held in Santa Fe, New Mexico, USA in November, 1992. The papers here have all been revised and gone through two rounds of peer reviews. The papers in this special issue represent an attempt to address some of the latest research issues raised above.

The first paper by Backes, et al., presents a local-remote telerobot control system which is being developed for time-delayed ground-remote control of space telerobotic systems. The system include a local site operator interface for interactive command building and sequencing of supervised autonomy and remote site: The *M*odular *T*elerobot *T*ask *S*ystem (*MOTES*). A command interpreter similar to one used on robotic spacecraft, is used to interpret commands received from the local site. Execution utilizes multiple control modules which execute the parametrization based on commands.

The second paper by Pin and Watanabe discuss two types of computer boards incorporating VLSI fuzzy inferencing chips in support of the addition of qualitative reasoning capabilities to real-time control of robotic systems. They discuss the implementation of formalism which they have developed to embody into fuzzy rule bases decision-making modules of approximate sensor-equipped robots. They present an application to the development of qualitative reasoning schemes for autonomous robot navigation in *a priori* unknown environments. Their results have indicated good efficiency navigation tasks performed in experiments.

Lumia, in the third paper, presents an architecture for telerobot control to implement specific applications for the Space Station of NASA. The architecture is hierarchical and has six levels of hierarchy. The paper describes the process by which a system based on this architecture can be developed.

In the fourth paper, Lee, et al., give a discrete-time representation of the Virtual Passive Control Approach for robust compensation for an experimental large space structure. The structure is located at NASA Langley Spacecraft Dynamics Branch in Virginia, USA. The results illustrate the robustness properties of the algorithm and indicate issues which need to be addressed in future research efforts.

In the fifth paper, Martinez, et al. propose a fuzzy logic-based intelligent control strategy to computationally implement the approximate reasoning necessary for handling the uncertainty inherent in the collision avoidance problem in mobile robots. The fuzzy controller was tested on an existing mobile robot system in an indoor environment and found to perform satisfactorily despite having crude sensors and minimal sensory feedback.

In the sixth and final paper, Jagannathan, et al. present a systematic approach for modeling and base motion control of a mobile vehicle. A nonlinear transformation, which accounts for complete dynamics with nonholonomic constraints, is used to obtain a linear system in space coordinates. An input-output linearization scheme is used for the inner loop which would transform the system to a point mass system in the coordinates corresponding to the control of objectives. The current result of this work would give mobility or robots in both Cartesian coordinates for tracking in these coordinates as well as achieving a desired final orientation, i.e. dock angel.

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