Advanced Sensing and Control Techniques to Facilitate Semi-Autonomous Decommissioning of Hazardous Sites

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Robert J. Schalkoff, Clemson University
Robert M. Geist, Clemson University
Darren Dawson, Clemson University

Research Objective

This research is intended to advance the technology of semi-autonomous teleoperated robotics as applied to Decontamination and Decommissioning (D&D) tasks. Specifically, research leading to a prototype dual-manipulator mobile work cell is underway. This cell is supported and enhanced by computer vision, virtual reality (VR) and advanced robotics technology. The overall goal of this phase of the research is to autonomously generate a specification of scene geometry using a stereo pair of camera images sufficient to produce a virtual replica of the sampled scene that is suitable for VR rendering and subsequent real-time robotic D&D operations, navigation, planning, and mission training.

Research Progress and Implications

This report summarizes work after 3.5 years of a 3-year project (no-cost extension of the above-referenced project for a period of 12 months granted).

The fourth generation of a vision sensing head for geometric and photometric scene sensing has been built and tested. Currently, we are developing estimation algorithms for automatic sensor calibration updating under robot motion.

We have modified the geometry extraction component of the rendering pipeline. Laser scanning now produces highly accurate points on segmented curves. These point-curves are input to a NURBS (non-uniform rational B-spline) skinning procedure to produce interpolating surface segments. The NURBS formulation includes quadrics as a sub-class, thus this formulation allows much greater flexibility without the attendant instability of generating an entire quadric surface. We have also implemented correction for diffuse lighting and specular effects.

The QRobot joint level control was extended to a complete semi-autonomous robot control system for D&D operations.

Currently, the project is at the critical stage where the three subsystems (imaging, VR and robotics) are being integrated and tested. We have also had extensive discussion with INEEL personnel who have expressed interest in this work in conjunction with the DOE DDROPS effort.

Planned Activities

Future research focuses on achieving the originally-stated project goals. This includes the synergistic integration of several emerging technologies. Specifically, we are combining fundamental manipulator control research with visual feedback/virtual reality research and applying the technologies to an industrial PUMA 560 robot manipulator. We plan a laboratory demonstration during the Summer of 2000.
Information Access

Publications


Web Page(s)

Our web page coverage of this activity may be found at the URL http://ece.clemson.edu/iaal/doeweb/doeweb.htm.