High Performance Mobile Manipulator Integration

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Introduction

In the main research project proposal “Autonomy for Automotive General Assembly”, we seek to demonstrate autonomy for automotive general assembly. The research requires the use of a mobile manipulator. The existing mobile manipulator at our disposal is a 5 DOF arm with 5 lb payload made by Metrica TracLabs (www.traclabs.com developed in the late 1990s) mounted on a RWI ATRV mobile base that was specifically designed for outdoor use. The Metrica robot arm does not have sufficient redundancy for assembly tasks and will not be dynamically responsive enough to track a moving “taskboard” for autonomous assembly. The current mobile manipulator accelerates slowly and has a limited top speed (0.5-1 inch/sec).

In order to demonstrate autonomous assembly tasks that we envision, we propose to integrate a mobile manipulator that will be able to meet the demands of the assembly task: dynamically responsive system with an accurate EOAT placement, precision control of mobile base, and highly redundant system that offers high degrees of manipulability.

This project will integrate state of the art components—a mobile base and a 7 DOF robot arm along with computing, sensors and wireless communication to produce a state of the art mobile manipulator. This function integration will utilize software infrastructure developed at Robotics Institute of Carnegie Mellon and demonstrated on many mobile manipulators.

We have investigated the options for the mobile manipulator and have located the top choice for a manipulator, 7DOF WAM, from Barrett Technologies (Figure 1) and a mobile base, PowerBot, from Mobile Robots Inc (Figure 2). We believe that the WAM arm represents the state of the art in robot manipulation today and the combination of these parts will result in a high performance mobile manipulator for autonomous assembly research.
In addition to the mobile base and arm, the following components will be necessary to provide the required sensing and control:

Onboard computing + wireless communication:

Vision sensors:
  http://www.sick.com/home/factory/catalogues/safety/espe/laserscanner/s300/s300professional/en.html

Pan-Tilt Unit:

**Tasks**

- Collaborate with GM MSR to investigate and identify all components needed for the system.
- GM provides all the components on loan to Carnegie Mellon
- Test components (base, arm, sensors, computing) individually
- System design of a functional mobile manipulator system including mobile base, WAM manipulator arm, fiducial tracker, vision cameras, PanTilt unit, and embedded computers
- Integrate all components for a functional mobile manipulator including mobile motion control algorithm
- Evaluate the system performance

**Deliverables**

- Dec. 10, 2007
  Report describing mobile robot integration design, system functionality and preliminary performance targets; Source code for entire functional mobile robot; $10,000.00

**Additional Information**

A total of two mobile manipulator systems will be integrated on site at Robotics Institute Carnegie Mellon University. One will be on loan to Carnegie Mellon University for conducting research “Autonomy of Automotive General Assembly” for the duration up to June 2009. The disposition of the loan will be determined at the end of main research project which has been scheduled on June 30, 2009. The other integrated mobile manipulator will return to GM immediately upon the successful function integration.