Lola, the mobile robot from NC State

Ricardo Gutierrez-Osuna, Daniel S. Schudel, Jason A. Janet and Ren C. Luo
Center for Robotics and Intelligent Machines
North Carolina State University
Raleigh, NC 27695-7911
rgutier, dsschude, jajanet, luo [@eos.ncsu.edu]

Introduction

The North Carolina State University team intends to participate in the 1996 Mobile Robot Competition and Exhibition with Lola, a Nomad 200. This year marks our third entry in this competition.

Robot description

Lola is a Nomad 200 with a standard 16-transducer sonar ring and tactile bumper sensors. We have taken advantage of the Nomad's modularity and moved 3 of the rear sonars to the front just above the bumper. This provides Lola with the ability to sense chairs and other potential obstacles that might otherwise be unseen.

Lola's main processor is a 486DX2-66 running Linux (Unix). The combination of Linux and wireless Ethernet makes code development on Lola a real joy. That is, from any workstation on the network (including the Internet) we can telnet to Lola and export the display for developing, debugging and executing code while monitoring Lola's status during operation, which beats having to wheel around a terminal and extension cord. The idea is to do all development without leaving your chair.

The vision hardware consists of an on-board image processor and a single RGB camera mounted on a pan/tilt unit. Lola's image processor was purchased from Traquair Data Systems and is blessed with two 'C40 DSP's running in parallel. Performing all computation on-board has several advantages: the video data is not corrupted by radio transmission noise, commands are not lost, and there is no communication lag that may result in Lola crashing into things. These findings are consistent with those of previous competitors. On the downside, the on-board image processor contributes significantly to the battery drain, which is partly due to its intended desktop use. Still, we are able to get about 2 hours of operation per charge.

Software

We intend to extend the software we used in the 1995 Mobile Robot Competition. As of this writing not all the modules have been implemented. The basic approach for each event has been determined and is summarized in the following sections.

Navigation architecture for Event I

The navigation architecture consists of the following modules:

- **High-level planning:** We perform path planning on the topological map of the arena. The map is searched for an optimal path to the goal location.
- **Navigation:** We use a Partially Observable Markov Decision Process to estimate the location of the robot in the topological map from dead-reckoning and sonar information.
- **Feature detection:** We use a Certainty Grid to extract topological features from the sonar information and find the robot's orientation with respect to the walls.
- **Low-level control:** Low-level control is based on "artificial forces", where the robot is attracted by a desirable state (i.e., follow a direction) and repulsed by sensed obstacles.

Perception/Manipulation for Event II

For this event we will use the following approach:

- **Perception:** The vision system on the robot and a color-histogramming technique are used to recognize and track tennis balls and the squiggle ball.
- **Manipulation:** We intend to design and build a 5-degree-of-freedom arm to retrieve the balls.
- **Neural networks:** It is expected that we will use a Region and Feature Based neural network for object detection/recognition and control of the arm.

Team members

Ricardo Gutierrez-Osuna, Daniel S. Schudel and Jason A. Janet are graduate students at NCSU's Electrical and Computer Engineering Department. Dr. Ren C. Luo is Professor and Director of the Center for Robotics and Intelligent Machines at NCSU.