FILM OF MARK I ROBOT (16 mm COLOR SILENT - 5 MINUTES)

Dr. John E. Dixon, Ms. Susan A. Bouchard,
Mr. William C. Kennedy, Dr. James H. Siegle

Naval Research Laboratory, Washington, D.C.

ABSTRACT

This film shows an autonomous robot in action. The goal of this NRL research effort is to establish a technical base for an autonomous underwater robot. It is expected that such a robot would be able to do only simple tasks, but would be able to do them one or two orders of magnitude cheaper than other methods. (The economy is mainly because it is not necessary for a ship to standby on the surface).

The robot vehicle would be programmed at a base and proceed to its assigned destination on the floor of the ocean. It would then carry out its work autonomously, without even a communications link.

This project is concerned with software rather than hardware. The Mark I Robot is a system designed to operate in the laboratory as a research tool. It is a simplified robot, a first cut at providing the minimal intelligence necessary for an autonomous underwater robot. The robot performed as expected, successfully carrying out the task it was assigned.

The main issues addressed are:

1. Sensor data collection. A touch sensor (a microswitch) held in the robots hand was chosen because it works in muddy water, and because it provides three-dimensional data which is relatively easy to process. Algorithms for searching (to find an object) and tracking (to explore the shape of an object) were developed and tested.

2. Object recognition. That is, the processing of raw sensor data into a form useful to the robot. In the Mark I robot a solid object model (a rectangular prism or block) is fitted by a kind of relaxation procedure to the data points collected by the touch sensor. This simple recognition scheme proved adequate to allow the robot to recognize and manipulate objects.

3. System Integration. That is, putting a complete robot together, and testing it in action to see how well the various modules work together and where the rough spots are.

The film shows the robot locating an object and then putting it into a basket. This is the laboratory version of the simplest task envisioned for the underwater robot, collecting geological samples.

First, the robot calibrates its tactile sensor by touching a straight edge of known location. This tells the robot exactly where the tip of the touch sensor is, in relation to the hand of the robot.

Next it searches and finds a block. Then it touches the block on four sides to determine size, shape, and orientation.

Finally, having determined that the block has acceptable size and shape, the robot discards its touch sensor, picks up the block and places it into a basket.

The robot moves quite slowly in the film. It was programmed to move at 20% of maximum speed for clear viewing. The robot also hesitates between moves. This is caused by communication delay between a large computer and a small one.