Brian Bairstow

16.412 Problem Set #1

Part A:

Cooperative Robotics

In cooperative robotics, the group of robots have the same goals, and thus it is most efficient if they work together to achieve those goals. They can simultaneously work on different aspects of the goals, or can combine their efforts to do tasks that aren't possible individually. If the problem is simple, or if enough is known about the situation, then the individuals can deduce what the other robots will do and thus what they need to do. However, this is often not the case and then coordination is required.

Machine Learning

Machine learning is essentially the recognition and extrapolation of patterns. This can be important to robotics, since the "artificial intelligence" of current robots is typically a set of commands for various circumstances. However, with elegant enough algorithms for machine learning, one can imagine a machine that can eventually teach itself unexpected things. This capacity to learn could develop an "artificial intelligence" which is more meaningful than an array of specifically instructed behaviors.

Neural Networks

Neural networks consist of nodes which pass data via links to other nodes. They are good at learning because the weightings of the links can be altered to adjust the output of the neural network. Thus the network can be trained on data until the outputs match the expected outputs. One use for this is to make parametric approximations of complicated models, so that a neural network can quickly come up with low fidelity results.

Part D:

Task Directed Imaging in Unstructured Environments by Cooperating Robots

Vivek A. Sujan

http://www.ee.iitb.ac.in/~icvgip/PAPERS/115.pdf

This paper covers visual sensing strategies for robots working on a task. The issue is to place sensors in order to see certain targets. Depending on the degree of sensor articulation, there is more or less leeway. With multiple robots sharing information, the problem of optimizing camera placements is more interesting. Sensor fusion can be used to combine the data, and areas which aren't visible from one robot could be viewed with the other robot. A goal is to create a 3D geometric model by using multiple sensors.

The paper goes on to describe an algorithm to optimize camera pose while considering factors such as depth of field, target resolution, and visibility. A simulation was run on the algorithm.

This paper brings up a useful topic for rovers working together in the same area. One consideration in planning of cooperative robots is combining their sensor data in useful ways. For instance, when traversing difficult terrain it can be useful for a stationary rover to observe a moving rover to make sure everything goes well. This paper is not applicable for programmatic planning such as how to assign rovers to different geographic areas, except that it suggests that rovers can work well together.