RIPS 2007: LANL Project Description

Project Title: Cooperation among autonomous robots and occlusion video tracking

During the last few decades, cooperation among autonomous robots has received significant attention. Dramatic developments in communication and computation technology relax the restriction on information exchanges among spatially distributed robots. The possibility has been identified that simple and inexpensive robots can carry out complicated tasks through cooperation. Applications include space exploration, automated highway systems, autonomous combat systems, oceanographic sampling, air traffic control, congestion control on the internet, and sensor networks.

Video tracking provides useful information for robot localization and cooperation. Occlusion video tracking is a challenging problem since particular objects become unreliable under occlusions. However, temporal information and real-time control feedback potentially benefit this problem and make it possible to implement real-time video occlusion tracking.

This project will have two parallel threads.

- Cooperation algorithms for autonomous robots. This part focuses on investigating and developing advanced distributed cooperation algorithms [JLM03, RSM04] for specific tasks. Those tasks include (but may not be limited to):
  - Cooperative boundary tracking;
  - Information fusion over sensor networks.
- Occlusion video tracking with temporal information. This thread includes:
  - Studying numerical solutions of PDEs [OS88] and investigating advanced image segmentation methods, such as Chan-Vese method [CV01], shape prior, Multiscale method, etc.
  - implementing real-time video tracking algorithms based on basic estimation theory.

This project will employ the autonomous robots and the video tracking system available at the UCLA Applied Mathematics laboratory.

References

[CV01] T. Chan and L. Vese. Active contours without edges. *IEEE Transactions on Image Processing*, 10(2):266–277, 2001.

[JLM03] A. Jadbabaie, J. Lin, and A. S. Morse. Coordination of groups of mobile autonomous agents using nearest neighbor rules. *IEEE Transactions on Automatic Control*, 48(6):988–1001, Jun. 2003.

[OS88] S.J. Osher and J.A. Sethian. Fronts propagating with curvature dependent speed. algorithms based on hamilton-jacobi formulations. *J. Comp. Physics*, 79:12–49, 1988.

[RSM04] R. Rlfati-Saber and R. M. Murray. Consensus problems in networks of agents with switching topology and time-delays. *IEEE Transactions on Automatic Control*, 49(9):1520–1533, Sep. 2004.