

## RIPS 2006: LANL Project Description

### **Project Title: Robotic path planning and visibility with limited sensor data**

Autonomous robotic systems equipped with limited sensors and limited a priori information about their environment must be able to discover their surroundings for navigational purposes. The problem becomes difficult when the sensor information is limited and energy consumption for exploration must be minimized.

This project will be split into two phases. The first phase will be an investigation by the team members into the algorithmic techniques that exist or are relevant for this sort of work. These include (but may not be limited to):

1. Visibility and its dynamics in a PDE based implicit framework [1]
  - a. Introduction to Level Set methods.
  - b. Numerical solutions of PDEs.
  - c. Optimal path construction for one and several observers in the presence of obstacles (with a priori knowledge of the obstacle shape).
2. Visibility of point clouds and mapping of unknown environments. [2]
  - a. ENO interpolation.
  - b. Dynamic path construction for one and several observers.
  - c. Finding the shape of unknown objects.

The second phase of the project will be to employ the robots available at the UCLA Applied Mathematics laboratory [3] to analyze their motion and sensor data. The robots are equipped with infrared sensors. These will be used to integrate visibility algorithms with sensor data in order to navigate within an unknown environment in the presence of obstacles.

[1] R. Tsai, L.-T. Cheng, S. Osher, P. Burchard, G. Sapiro, "Visibility and its dynamics in a PDE based implicit framework" JCP, 199 (2004), 260-290

[2] Y. Landa, R. Tsai, L.-T. Cheng, "Visibility of Point Clouds and Mapping of unknown Environments", UCLA CAM report (06-16)

[3] C.H. Hsieh, Y.-L. Chuang, Y. Huang, K.K. Leung, A.L. Bertozzi, and E. Frazzoli, "An Economical Micro-Car Testbed for Validation of Cooperative Control Strategies", to appear in the Proceedings of the ACC 2006

[4] C.-Y. Kao and R. Tsai, "A Level Set Formulation for Visibility and Its Discretization", UCLA CAM report (06-04)

[5] L.-T. Cheng and R. Tsai, "Visibility Optimization using Variational Approaches", UCLA CAM report (04-03)