**Suggestions for Class Projects for EE290T, Fall 2011**

My group at UC Berkeley is involved in 3D modeling of indoor environments using a human operated backpack system equipped with a variety of sensors such as laser scanners, cameras, inertial measurement units, orientation measurement units, etc.

There are few steps in building photo-realistic 3D indoor models: (a) localize the backpack and hence all the sensors that are rigidly mounted on it; (b) construct a 3D point cloud using the laser scanners and the localization results from a; (c) reconstruct a surface to the point cloud by either plane fitting, or other algorithms (d) texture map the final results. There are a number of mini-projects I can propose to those students still looking for a topic for the term paper.

1. **3D simultaneous localization and mapping (SLAM) for indoor environments**:

Steps (a) and (b) in the above description can be combined using SLAM, which is a well known technique in robotics. While traditional SLAM is used for 2D mapping, its extension to 3D is still an open problem, especially when the range finders are “line scanners”, rather than true 3D range scanners. To do this project, you would need to read the first 8 or 9 chapters of Sebastian Thrun’s book on Probabilistic Robotics in order to become familiar with SLAM. You then need to mathematically develop a 3D SLAM algorithm that would be suitable for our set of sensors, and implement part or all of it in Matlab to demonstrate the effectiveness on real data. Data will be supplied to you for all sensors.

1. **Visual localization using Omni-directional Cameras**

This project involves the use of omni-directional cameras to localize the backpack system. We currently have two omni-directional cameras on our backpack facing away from each other. So, in a sense, we capture the entire 360 degrees of a scene. A good starting point for this project is the PhD thesis of Peter Hansen:

[**http://eprints.qut.edu.au/37667/1/Peter\_Hansen\_Thesis.pdf**](http://eprints.qut.edu.au/37667/1/Peter_Hansen_Thesis.pdf)

You would then mathematically develop an algorithm for vision based localization, followed by Matlab implementation. Data will be supplied to you.

1. **Texture mapping of planes using a moving camera**

This project involves estimating homographies among cameras looking at the same plane and then texture mapping that plane using the estimated homographies. Chapters 6 and 9 of Rick Szeleski’s textbook should be enough for you to get going on this project. You would need to develop the code in Matlab, and the data will be supplied to you.