# Applicability of Deep-Learning Technology for Relative Object-Based Navigation

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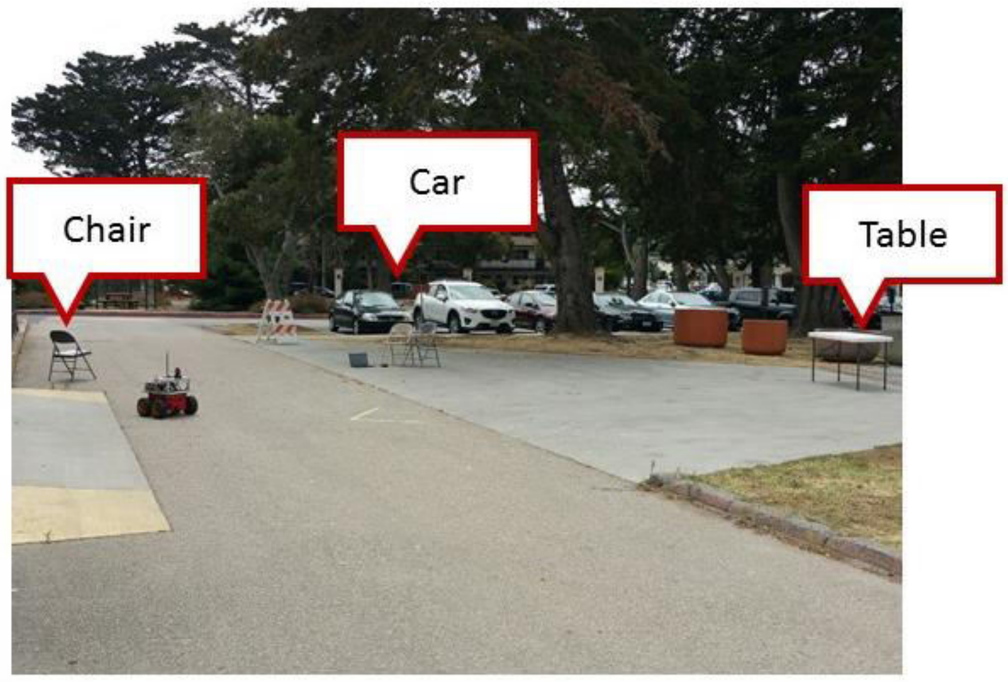
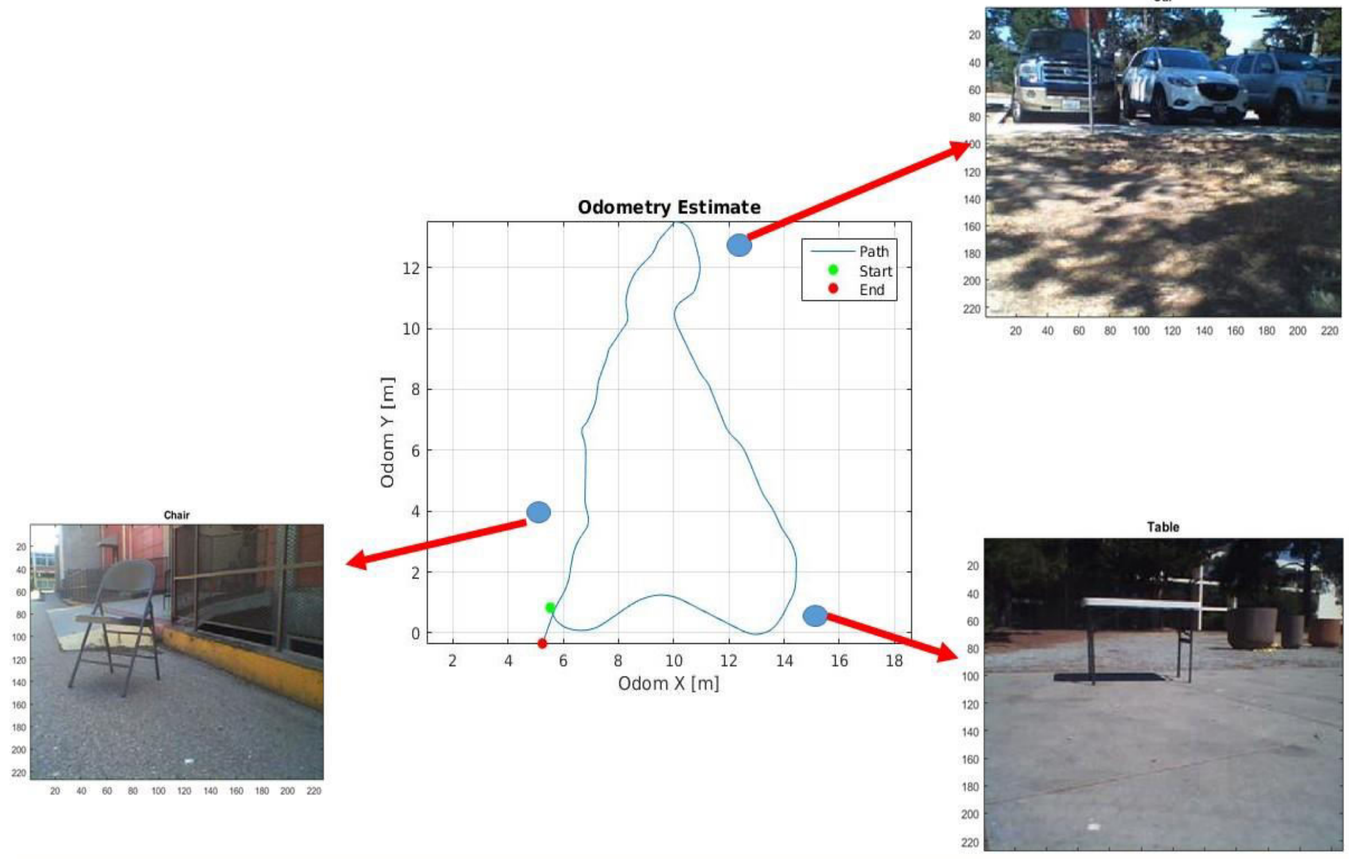
This thesis explored the applicability of deep-learning technology for relative object-based navigation in an urban environment with a degraded GPS signal. In such a critical mission, using just GPS, static sensors and map data as the navigation tool is not sufficient. There is a need to involve additional sensors including cameras. The optical sensor is a popular choice as it can collect tremendous amounts of information such as live video feeds, video recording, capture static image, video analytics and object recognition. This information aids the UGV and operators in understanding the environment and planning/ adjusting the course of actions.

The deep-learning technology explored in this thesis is a subset of machine learning. It utilizes convolutional neural network (CNN) to learn the image features automatically from large repository of training image dataset. There are three techniques that can be successfully deployed for CNN on image classification and this thesis used one of them, the transfer learning approach. This approach happens to be more practical to use with an existing pretrained model such as Alexnet to improve the image classification accuracy due to small training data.

Test Setup to identify Table, Car & Chair




| | Percentage of Correct Identifications | | | |
|---|---|---|---|---|
| **Test Case** | **Chair** | **Two Chairs** | **Table** | **Table/Car/Chair** |
| **Dataset with 20 training images** | 30% | 50% | 70% | 70% |
| **Dataset with original 20 plus new 20 training images** | 80% | 60% | 70% | 87% |
| **Dataset with 39 training images from above plus 1 image of the actual scene** | 100% | 100% | 80% | 93% |

Based on the results, the dataset with 39 training images from above plus 1 image of the actual scene obtained the overall best results. The good results could be attributed to having an actual image of the targets in the dataset.

It is recommended to further explore obstacle avoidance using deep-learning technique. This implementation would enable UGV to navigate autonomously without knocking into an object. The deep-learning technique shall assist the Pioneer UGV system to recognize the object and determine best route to avoid the obstacle.