White Paper on Obstacle Detection via a Stereoscopic Camera System, Using Deep Learning

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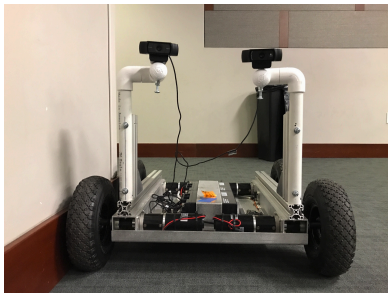
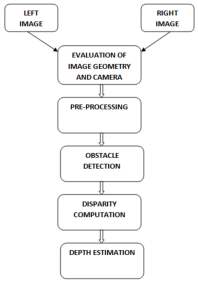
1 Project Description

We are enhancing a rover (see Figure 1a) to have stereoscopic vision [4], so that we can carry out data acquisition and binary classification of whether the rover has detected static or dynamic obstacles. To modify the rover, we mounted video cameras and a laptop to sample images from the video cameras, and perform real-time data acquisition by sampling greyscale images from the video cameras. Subsequently, our *Python* program will implement binary classifiers for the the aforementioned tasks. The classifiers will use deep learning [2, 7, 8, 6, 10, 1, 3, 5], specifically an inception-based convolution neural network (CNN) architecture [9]. We plan to enhance the classifer by using stereo matching, disparity map computation, and depth estimation. Figure 1b [4].



(a) Photograph of the enhanced rover



(b) "Flow dragram for obstacle detection" [4]

We aim to perform obstacle detection for a rover traveling at a speed of 20 m/s. We aim to classify static obstacles 30 m away, so that the controller of the rover has time to manipulate the rover away from the obstacles. In addition, we aim to classify moving obstacles at speeds greater than 0.2 m/s.

Fix this description!!!

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2 Work-Breakdown Structure and Project Status

The initial distribution of tasks and project status are described as follows:

1. Michael Bass modified a rover to mount two video cameras and a laptop, so that
2. Khaled Nakhleh develop a *Python script* to sample greyscale images from video cameras mounted on the robotic cyber-physical system.
3. Drupad Khublani and Venkata Pydimarri suggested some techniques, and will examine CNN-based techniques for detection of static and dynamic obstacles.
4. Zhiyang Ong wrote the white paper.

Moving forward, Khaled Nakhleh and Michael Bass will develop *Python* scripts for preprocessing (e.g., decrease the resolution of the images) of the greyscale images from the video cameras, for statistical analysis of the experimental data, and for visualizing experimental data so that we can obtain figures/plots to include in the final report. Drupad Khublani and Venkata Pydimarri will implement the *Python* scripts for deep learning, via a CNN, that will classify the sampled greyscale images into obstacle detected or no obstacle detected. Lastly, Zhiyang Ong would be in charge of writing the final report, with assistance from other team members.

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