**Literature Review # 2**

**Paper:** Anikstein, Alex. IGVC Red Raven 2.0. *California State University*, pp. 9- 11. June 2012.

**Summary:** The Red Raven 2.0 robotic platform competes at the Intelligent Ground Vehicle Competition (IGVC) and focuses on different aspects of image processing and recognition necessary to detect edge boundaries and obstacles ranging from trashcans to construction barrels. They used a parallel flowchart approach that started by filtering out grass and obstacles in their pre-processing stages. They used RGB and HSV thresholds to detect lines and obstacles necessary for the creation of separate types of filters. Once a grass filter and an obstacle filter were created, the obstacle filter was subtracted from the grass filter to create an image that only displays the white lines. The Red Raven team then proceeded to pass a small particle filter to reduce the noise from discontinuous areas or random bright spots in the grass. After they created an image that only contained the distinguishable white lines, they applied a Canny Edge Detection algorithm to obtain edge information. The team then used a convex hull operator to create an image of solid non-discontinuous lines which then they applied another small particle filter to remove noise in the lines. Finally, the team corrected for the distortion of the line image by converting it into a polar histogram which contains information about the line boundaries.

**Applicability:** The Rose-Hulman Robotics Team is in the procedure of building an intelligent ground robot. Since our type of application also involves the IGVC, most of the features mentioned in this paper are potentially useful. The most significant feature about the approach mentioned in the paper was the parallelism of the obstacle and line detection. This will help us reduce processing time which can be used to achieve a quicker and faster response from our robot.

**Issues:** One of our main concerns is that the actual environment where the robot will be performing does not consist of uniform grassy field. Discontinuities in the grass, such as a brown patches of grass, might not be detected by the grass filter and might pass as an obstacle. Other potential problems consist of the brightness that the camera will experience. Bright spots of light created by the horizon line or reflective surfaces might fool the algorithm into thinking that it is a white line. Finally, since the line detection is dependent on the obstacle detection filter, if the obstacle detection filter fails, the line detection will also fail.

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