Robotics and Autonomous Systems Thesis Defense

Computationally Efficient Object Detection Strategy from Water Surfaces with Specularity Removal

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Abstract

Floating trash objects are very commonly seen on water bodies such as lakes, canals and rivers. With the increase of plastic goods and human activities near the water bodies, these trash objects can pile up and cause great harm to the surrounding environment. Using human workers to clear out these trash is a hazardous and time-consuming task. Employing autonomous robots for these tasks is a better approach since it is more efficient and faster than humans. However, for a robot to clean the trash objects, a good detection algorithm is required. Real-time object detection on water surfaces is a challenging issue due to nature of the environment and the volatility of the water surface. In addition to this, running an object detection algorithm on an on-board processor of a robot limits the amount of CPU consumption that the algorithm can utilize. In this thesis, a computationally low cost object detection approach for robust detection of trash objects that was run on an on-board processor of a multirotor is presented. To account for specular reflections on the water surface, we use a polarization filter and integrate a specularity removal algorithm on our approach as well. The challenges faced during testing and the means taken to eliminate those challenges are also discussed. The algorithm was compared with two other object detectors using 4 different metrics. The testing was carried out using videos of 5 different objects collected at different illumination conditions over a lake using a multirotor. The results indicate that our algorithm is much suitable to be employed in real-time since it had the highest processing speed of 21 FPS, the lowest CPU consumption of 37.5\% and considerably high accuracy of 90.6\% on average in detecting the object.

July 6, 2021; 11 AM;

Zoom Link: https://asu.zoom.us/j/8380144932