Robotics and Autonomous Systems Thesis Defense

Navigation and Dense Semantic Mapping with Autonomous Robots for Environmental Monitoring

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Abstract

Autonomous Robots have a tremendous potential to assist humans in environmental monitoring tasks. The past decade has seen an unprecedented growth in the development and deployment of robots in every conceivable application domain. In order to generate meaningful data for humans to analyze, the robots have to collect high quality data with very low margin of error. This is achieved by employing scalable and robust navigation and mapping algorithms that facilitate acquiring and understanding data collected from the array of on-board sensors. To this end, this thesis presents navigation and mapping algorithms for autonomous robots that can enable robot navigation in complex environments and develop real time semantic maps of the environment. The first part of the thesis presents a novel navigation algorithm for an autonomous underwater vehicle that can maintain a fixed distance from the coral terrain while following a human diver. This algorithm was tested on three different synthetic terrains including a real model of a coral reef from Hawaii. The second part of the thesis presents a dense semantic surfel mapping technique based on top of a popular surfel mapping algorithm that can generate meaningful maps in real time. A semantic mask from a depth-aligned RGB-D camera was used to assign correspondences to the surfels which were then updated with multiple measurements. The mapping algorithm was tested with simulated and real data from an RGB-D camera and the results were analyzed. All the algorithms presented have been made openly available for the research community.

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Zoom Link: https://asu.zoom.us/j/9860206045