Multi-Sensor Mobile Robot Localization For Diverse Environments

Joydeep Biswas and Manuela Veloso

School Of Computer Science, Carnegie Mellon University,
Pittsburgh, Pennsylvania 15213, USA
{joydeepb,veloso}@cs.cmu.edu

Abstract. Mobile robot localization with different sensors and algorithms is a widely studied problem, and there have been many approaches proposed, with considerable degrees of success. However, every sensor and algorithm has limitations, due to which we believe no single localization algorithm can be "perfect," or universally applicable to all situations.
Laser rangefinders are commonly used for localization, and state-of-the-art algorithms are capable of achieving sub-centimeter accuracy in environments with features observable by laser rangefinders. Unfortunately, in large scale environments, there are bound to be areas devoid of features visible by a laser rangefinder, like open atria or corridors with glass walls. In such situations, the error in localization estimates using laser rangefinders could grow in an unbounded manner. Localization algorithms that use depth cameras, like the Microsoft Kinect sensor, have similar characteristics. WiFi signal strength based algorithms, on the other hand, are applicable anywhere there is dense WiFi coverage, and have bounded errors. Although the minimum error of WiFi based localization may be greater than that of laser rangefinder or depth camera based localization, the maximum error of WiFi based localization is bounded and less than that of the other algorithms.
Hence, in our work, we analyze the strengths of localization using all three sensors - using a laser rangefinder, a depth camera, and using WiFi. We identify sensors that are most accurate at localization for different locations on the map. The mobile robot could then, for example, rely on WiFi localization more in open areas or areas with glass walls, and laser rangefinder and depth camera based localization in corridor and office environments.

Keywords: Localization, Mobile Robots, Sensor Fusion

1 Introduction And Related Work

Localization is an ability crucial to the successful deployment of any autonomous mobile robot, and has been a subject of continuous research. As technologies have evolved, we have seen a parallel evolution of algorithms to use new sensors, from SONAR, to infrared rangefinders, to vision, laser rangefinders, wireless