Abstract

In this work, we focus on radiation field that could be generated after the nuclear accident or the attack of Radiological Disperse Devices (RDD) which is commonly known as Dirt bomb. Since harmful radioactive substance unleashed in this situation could cause public health and environmental damage, we want to develop the ability for robots to detect quickly and localize the illicit radiation sources.

There are several ways to get the knowledge of the radiation field. One way is to use the static sensor network distribute throughout the area of interest and iteratively estimate the field. However, static sensor network requires high both deployment density and communication/computational loads to provide good accuracy. The most efficient use of sensor can then be achieved using the aerial robots, where each sensor equipped with the robot can explore many different locations.

This thesis describes work in deploying a single Unmanned Aerial Vehicle (UAV) to map the radiation field, and to localize the radioactive sources. Modern UAVs have gained great popularity in the recent year both in research and commercial platforms. Deploying such UAVs in radiation fields are attractive because they allow using the robotic sensors in unstructured and cluttered environments. Furthermore, for many applications, the mission to be performed is time-limited, meaning that a rapid mapping or localization is required to minimize losses.

We bring together results from our application of four distinct problems in radiation fields. Firstly, we seek the radioactive hotspot in unknown radiation fields, where the robot makes an online path planning with myopic observations. Secondly, we estimate environmental boundaries of unknown radiation fields with an apriori known threshold value. Thirdly, accounting the cumulative effects of the sources, we seek a framework to localize the radioactive sources efficiently. Finally, we attempt to solve another problem of radiation fields that is the determination of multiple regions of interest.

We design path planners that enable the UAV to perform above mentioned tasks. We have implemented a trajectory controller to validate our assumption (related to the robot localization). We also show numerical results of experiments which are demonstrated in simulated environments.

Keywords. UAV, Radiation field, Path planning, Source localization, Contour.