Hostile Radar System Detection Approximation of an Electromagnetic Field Using Gaussian Process Regression and High-Intensity Source Avoidance Using a Hough Transform

DePasquale, Nicholas (School: Vanguard High School)

This project is an integrated approach to approximating an unknown scalar field using Gaussian Process (GP) Regression with a ground robot. The challenge stems from the safety constraints of the robot, where exposure to high-intensity regions inside the scalar field leads to damage or detection of the robot. To keep the robot safe during the measurement process, this project integrates GP regression and the Hough Transform to approximate the actual high-intensity regions of the scalar field using circular shapes, leveraging the GP posterior information. The developed algorithm is tested in a simulated environment and an indoor lab (the robot is moved around the lab space using a pre-coded manual movement system to collect initial data that is then used in the simulated environment), and was coded in MATLAB to prove the efficiency of the algorithm. The results of the experimentation showed that the algorithm developed for testing proved to not only be more efficient than other types of regression analysis tests, but also accurate as the lowest error rate found was 17% with only 50 sample points, with continuation into percents as low as 10% at 20 samples as the focus of a project continuation. Implementation of such a system in military reconnaissance technology would not only decrease military spending on reproduction of devices that might have been damaged or detected in the field, but also increase the efficiency of reconnaissance missions in which speed, accuracy, and risk are all optimized.

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