Search and Active Localization for Monitoring Invasive Species

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Searching for Stationary Targets

Carp are suspected to loiter in certain regions of the lake. We obtain bearing measurements using sampled signal strength by rotating the antenna. We provide a method to adaptively search these regions in order to localize them.

Searching for a Random Walking Target

Set of discrete nodes on a line segment [0, 1, ..., N].

Problem Statement: Find the strategy that maximizes the probability of capture given limited time and energy.

Single Robot Localization using Bearing Measurements

Once the robot finds the cluster of fish, we use bearing measurements to localize each of them to map out the cluster.

The goal is to localize a static target to desired precision as quickly as possible.

• We obtain bearing measurements using sampled signal strength by rotating the antenna.

• These measurements are fused to improve the estimate of the target location.

• Each measurement location is determined by an online, adaptive algorithm.

• We provide guarantees on the time to localize any tag.

• ... and prove the near-optimality of the measurement strategy.

• Repeated field experiments show the theoretical bounds hold in practice.

Single Robot Localizaiton using Bearing Measurements

\[
\max_{T(\text{OPTIMAL})} T \leq 5.439
\]

Multiple Robot Collaborative Localization of Stationary Target

Ongoing work is focused on two subjects: Moving Targets, and Coordinated Tracking Using Multiple Robots

• Two measurements taken near each other are less informative.

• The estimate is more precise when robots separate.

• However, they must meet to communicate and update their collective estimate.

• We simultaneously optimize

• We provide an approximation of the optimal algorithm for many communicating robots to locate a stationary target

\[
T(\text{OPTIMAL}) \leq \log \lambda
\]

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