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Inventors

Aniket Shirsat

Spring Berman

Contact

Physical Sciences Team

Decentralized Multi-Target Tracking Using Multiple Quadrotors

-Background Mobile ground robots and aerial robots have often been used for exploration and mapping tasks. Many multi-robot control strategies rely on a centralized communication network for coordination; however, these strategies do not scale well with increasing robot population size, as the communication bandwidth becomes a bottleneck. Although decentralized multi-robot control strategies can be used to overcome these limitations, communication among robots may still be degraded by environmental factors and movement of robots beyond communication range. Furthermore, in real-world robot tracking of multiple targets, these issues are compounded by uncertainties in the existence and locations of targets, as well as susceptibility of sensor measurements to noise and false detection. Invention Description Researchers at Arizona State University have developed a methodology for detecting and tracking an unknown number of static targets using a swarm of aerial vehicles with intermittent to no network connectivity. The quadrotors search for targets along a spatial grid overlaid on the environment by performing a random walk on this grid modeled by a discrete-time discrete-state (DTDS) Markov chain. Use of random finite set (RFS) models and probability hypothesis density (PHD) filters provide a probabilistic framework for multi-target tracking with statistical guarantees on the accuracy of the estimated number of targets and their states. This approach has been validated with simulations of varying densities of robots and targets, and it is assumed that a quadrotor is only able to communicate with another if they occupy the same location on the grid. Potential Applications • Autonomous vehicles • Target tracking • Decentralized sensor networks • Search and rescue Benefits and Advantages • Permits high scalability for large swarms of robots • Circumvents risks associated with centralized network failures • Decentralized communication relaxes network topology constraints Related Publication: Decentralized Multi-target Tracking with Multiple Quadrotors using a PHD FilterResearch Homepage of Professor Spring Berman