Announcing the Final Examination of Hadi Hajieghrary for the degree of Master of Science

Time & Location: July 9, 2013 at 10:00 AM in Engineering 1 307D
Title: ON RADAR DECEPTION, AS MOTIVATION FOR CONTROL OF CONSTRAINED SYSTEMS

Cooperative multi-agent systems are ubiquitous due to major advances in communications and process capabilities. They are applicable in diverse fields from localization and mapping to robotic production lines. Collective motion control brings up special issues in trajectory generation and control design at the local agent level to fulfill a team goal while not violating its own limitations and team constraints.

Here, a team of fixed winged Unmanned Arial Vehicles cooperate to deceive a ground radar network into seeing a spurious phantom track in its scope. Radar detects the presence of a target by listening into the echoes of its transmitted radio waves, bouncing off of the target. In this scenario, each UAV is capable of intercepting radar signals, delaying, and re-transmitting them to be received by the radar. Thus, each UAV could deceive its corresponding radar to see a spurious phantom instead of the real UAV. In the case of a network of ground radars, a team of coordinated UAVs can cooperate to shape a consistent phantom track that is falsely detected and confirmed by the network of radars as a real vehicle. This problem serves as motivation for a geometric approach to formation control of constrained systems.

In this thesis, an object oriented program is developed in the Matlab software area to simulate the control strategies in a scalable fashion. Object oriented programming is a naturally suitable method to simulate a multiagent system. It gives the flexibility to make the code more close to a real scenario with defining each agent as a separated and independent identity. This code consists of three general classes: Radars, UAVs, and the Simulation Scene which acts as the central intelligence, control the communications, and coordinate the agents.

Several issues come up during the simulation of this system: choosing feasible initial values for the agents so that they could keep the formation and fulfill the mission objective; this leads to a more general problem of finding a feasible set in the configuration space of the multiagent system. After finding this set, the natural next step is to find the optimal trajectories of the agents in the sense of minimum fuel, minimum time, and etc.

The main objective is to understand the nature of the constrained dynamic problems, and examine various solutions. Each solution presented here provides some advantages along with its own limitations and disadvantages. This helps us to select a proper algorithm, combine them to back up each other, or devise a whole new algorithm fit to our needs. Using the flexibility of this code, we could simulate several scenarios, and incorporate various conditions on the system. Also, we could have a close look at each agent to observe its behavior in these situations. In this way we will gain a good insight of the system which could be used in designing of the agents for specific missions.

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Approved for distribution by Suhada Jayasuriya, Committee Chair, on June 25, 2013.
The public is welcome to attend.