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M.Sc. or Ph.D. Research topic:

Unmanned Aerial Vehicles Cooperative Decision and Control under Severe Uncertainty

Summary

The proposed research is concerned with cooperative decision and control under severe uncertainty of autonomous unmanned aerial vehicles (UAVs). A scenario of interest is that of a team of UAVs searching cooperatively for stationary ground targets. Information in this type of scenario, regarding the location and identity of targets, the dynamic model of the UAVs, and team members' actions, is typically accompanied by severe uncertainty. Optimizing the group plan for trajectories and assignments without taking into account uncertainty may result in degraded performance. The info-gap approach is distinctive in attempting to satisfice quality of the outcome rather than optimizing it. This leads to satisfactory solutions which leave the greatest room for error, and therefore, the greatest robustness to uncertainty. Such an approach is preferable when great uncertainty characterizes a large portion of the data, as in the cooperative search problem mentioned above. The research will focus on developing novel cooperative robust strategies using info-gap theory. Monte Carlo simulations will be used to validate the theoretical results. A UAV test-bed will be developed in the first year and used subsequently for experimental verification. The research is expected to lay the foundation for the development of robust cooperative control strategies in general multi-vehicles multi-targets scenarios.

Research Goals

Our goal is to study the use of info-gap theory in cooperative search problems with severe uncertainty. When considering such uncertainties, one seeks answers to planning questions such as:

- What is the preferable deployment of the UAVs (centralized vs. decentralized)?
- How much inaccuracy in the UAVs' dynamic model can be tolerated?
- How coordinated must the teammates' actions be?
- Should we optimize or satisfy group performance?

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