Embedded Control and Autonomy for Networks of Unmanned Vehicles

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Unmanned Aerial Vehicles are already beginning to be ubiquitous in a number of different applications and at a wide variety of scales. While UAV platforms are being developed in a variety of creative ways, (including, for example, a MEMS flying insect version at Berkeley) it is fair to say that key problems still remain in developing embedded and autonomous software for control of networked UAVs.

At Berkeley we have been interested in embedded software for semi-autonomous agents. This software is characterized by the interaction between discrete decision making and continuous control, organized in hierarchical fashion. Our design methodology for the design of embedded software is to be considered an alternative to the verification based approaches to hybrid control systems design.

In today's talk, I will focus on issues for the design of embedded and autonomous algorithms for coordinating groups of Unmanned Aerial Vehicles (UAVs). Problems to be addressed include:

1. Design of real-time multi-sensor control.

2. Vision based landing and navigation.

3. Pursuit Evasion problems for multi-UAV missions.

The last set of issues touches on issues of decentralized map making, computationally tractable solutions of pursuit evasion games with partial information. Networking protocols, dynamic caching of intermittently available information and other communication issues are interesting issues which cannot be covered for lack of time.

The work on UAVs is joint with (in alphabetical order) Joao Hespanha (USC), Frank Hoffmann(KTH-Stockholm), Hyoun Jin Kim, John Koo, Cedric Ma, Maria Prandini (Brescia), Peter Ray, Omid Shakernia, David Shim, and Claire Tomlin (Stanford). More recently, the group has also included Tulio Celano, Will Morrison, Santosh Philip, Shahid Rashid, Bruno Sinopoli, Rene Vidal.