THE UNIVERSITY OF ARIZONA
College of Engineering

Aerospace and Mechanical Engineering Seminar

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Small UAV Autonomy: Time-Coordinated Missions

Abstract: The urgent need to integrate Unmanned Air Vehicles (UAVs) into the national airspace requires that these vehicles possess high levels of autonomy and are capable of executing complex missions in a safe, reliable manner. A large subset of these missions requires that UAVs arrive at their final destinations either at the same time or separated by pre-defined time intervals.

This first part of the talk will introduce many examples of such missions and will proceed to discuss in some detail the technologies involved. A representative example includes the challenging mission scenario where the vehicles are tasked to cooperatively execute collision-free maneuvers and arrive at their final destinations at the same time (time-critical operations). In the setup adopted, the vehicles are assigned nominal spatial paths and speed profiles along these paths. The paths are then appropriately parameterized and the vehicles are requested to execute cooperative path following, rather than "open loop" trajectory tracking maneuvers. This strategy yields robust behavior against external disturbances by allowing the vehicles to negotiate their speeds along the paths in response to information exchanged over the dynamic inter-vehicle communications network.

The talk addresses explicitly the situation where each vehicle transmits its coordination information to only a subset of the other vehicles, as determined by the communications topology. Furthermore, we consider the case where the communication graph that captures the underlying communications topology is disconnected during some interval of time or even fails to be connected at all times. Conditions are given under which the complete time-critical cooperative path-following closed-loop system is stable and yields convergence of a conveniently defined cooperation error to a neighborhood of the origin. Flight test results demonstrate the efficacy of the multi-UAV cooperative control framework presented in this part of the talk.

Bio: Isaac Kaminer received PhD in Electrical Engineering from University of Michigan in 1992. Before that he spent four years working at Boeing Commercial first as a control engineer in 757/767/747-400 Flight Management Computer Group and then as an engineer in Flight Control Research Group. Since 1992 he has been with the Naval Postgraduate School first at the Aeronautics and Astronautics Department and currently at the Department of Mechanical and Aerospace Engineering where he is a Professor. He has a total of over 20 years of experience in development and flight testing of guidance, navigation and control algorithms for both manned and unmanned aircraft. His more recent efforts were focused on development of coordinated control strategies for multiple UAVs and vision based guidance laws for multiple UAVs. Professor Kaminer has co-authored more than a hundred refereed journal and conference publications.

Thursday, November 5th at 4:00 pm

Zoom link: Email eperumala@ariona.edu