Title:

A Structurally-Adaptive Framework for Distributed Airborne Sensing over Real-time Collaborative Information Sharing Networks

Authors:

Corey Ippolito, Vahram Stepanyan, Thomas Lombaerts, Keerthana Kannan, George Gorospe, Chester Dolph, Evan Kawamura , Wendy Holforty, Nelson Brown, A.J. Jaffe

Abstract:

The emergence and maturation of wireless communication technologies continue to transform the aviation industry and are enabling new solutions to challenges faced by NASA's Advanced Air Mobility (AAM) initiative. AAM is leading towards high-density autonomous aircraft operations in areas underserved by traditional aviation, such as over densely populated urban centers. In this paper, we build on concepts from Smart Spaces - where sensing, processing, and communication are embedded in an environment, and agents are operating within the space can exploit these capabilities in real-time through collaborative information sharing networks. Building from these concepts, we propose a framework to enable a dynamic, topologically-adaptive, and distributed estimation system for man-rated aviation to address challenges faced by autonomous AAM operations. This paper presents the initial concept of operations and system design for this framework, presents a mathematical formulation for abstraction of the problem, identifies requirements and constraints for operation, and presents algorithmic constructs and mathematical formalisms to demonstrate operation. The proposed framework will be evaluated on a regional AAM flight scenario and will focus on two initial applications: (1) GPS-free navigation supporting precision approach and landing (PAL), and (2) surveillance and conformance monitoring of aircraft in vertiport airspaces. Such approaches show promise in addressing gaps in current technologies needed to enable future AAM concepts, while promising greater capabilities, performance, robustness, and safety over current aviation systems and operations.