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Title

All-in-one integrated UAV avionics architecture with AI capabilities and 5G connectivity

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Abstract

Unmanned Aerial Systems (UAS) are becoming more and more advanced and autonomous over the past decade. Therefore, there is a constantly growing demand for the increased computational power onboard and reliance on real-time broadband connectivity for online workflows and edge computing. Most of the traditional autopilots for UAV are based on 32-bit microcontroller running RTOS (Real-Time Operating System)[1] and incorporating MEMS (Micro Electro-Mechanical Systems) sensors and GPS-based navigation [2]. This hardware architecture approach with a software running EKF (Extended Kalman Filter) algorithm allows to determine attitude and position precisely allowing the UAV to navigate autonomously and fly using waypoints. However, more advanced methods of navigation and obstacle avoidance require additional sensors and more complex software algorithms to be used. VIO (Visual Inertial Odometry), SLAM (Simultaneous Localization and Mapping) are just to name a few and all of them require video processing onboard or on the edge [3]. Obviously, microcontroller computing resources are not enough for these tasks. That's why SoM (System on Module) running Embedded Linux are often being used as an addition to the traditional autopilot interfacing via serial interface (lower bandwidth option) or Ethernet (higher bandwidth option). However, this approach is not a representation of a tight and light weight integration, in addition it requires interfacing software to be implemented in each specific use case. The proposed architecture approach combines FMU (Flight Management Unit) and MC (Mission Computer) in a single tightly-integrated unit providing high-speed reliable communication between the two. In addition, the architecture includes 5G connectivity modem [4] which provides network access with up to 600 Mbps bandwidth. This approach allows to implement edge computing and distributed calculations as well as collaborative swarm UAV activities. This paper describes the hardware and software architecture in more details, outlines the navigation and control algorithms being used for the next generation onboard and connected decision making for UAS operations.

References

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