Addendum: UAV Avionics

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The avionics include any component of the unmanned aircraft systems. These components typically communicate and are electrically driven.

- The *primary roles* of avionics include the implementation of the flight control system, navigation system, mission management.
- The secondary roles of the *subsystems* include electrical power system, actuation system, payload control systems, etc.
Primary Systems

Vehicle Management System (VMS) and Mission Management System (MMS)

- VMS performs the flight critical functions such as autopilot and operator interface, waypoint or route selection, etc.
- MMS mission critical functions e.g., payload control, data integration, high-level planning, etc.

The functions of the VMS and MMS are not always segregated.

Flight Control System

- UAVs’ flight control system is essentially an autopilot that provides different mode of operator interactions.
- Modes include radio controlled (e.g. for landing and takeoff), remote piloted (operator provides outer-loop input such as velocity) and autonomous (following pre-planned routes).
Navigation/State-Estimation System

- Provides the estimates of the aircraft state (velocities, position, attitude and heading and their rates).
- Realized through the integration of multiple sensors, including: GPS, inertial sensors, magnetic compass, air-data probes.

Situational Awareness System

- Provides data about the UAV surrounding, e.g., terrain, obstacles. Mainly used for autonomous control or automatic landing.
- Simple systems are realized through above ground sensors such as laser and radar altimeters, or optical flow sensors. More advanced systems use full-fledge radars, scanning lasers or flash lasers or vision based sensors.
Physical considerations

- The avionic systems rely on sensors that are themselves electrical or microelectromechanical systems MEMS, and other components such as actuators, propulsion control units and electrical power sources that often incorporate smart features.

- Information about these systems and components has to be made available at multiple system levels.

It is important to include avionics during the conceptual design. Some of the considerations include:

- Architectures, wiring, cooling, maintenance, etc.
- Vibration, temperatures, electromagnetic (EM) interferences, humidity, etc.
Functional Architecture

This figure illustrates a typical functional architecture for a UAV. Notice how, although key functions are segregated, the different functions rely on common sets of measurements. Therefore, when designing bus architecture, it is important to consider how the various components interact, the modularity that may be required for future extensions, and considerations such as the impact of failures.

\(^a\)Figure from [1]
Architecture and Flight Software
References


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