Mission Oriented Sensor Arrays – An Approach towards UAS Usability Improvement in Practical Applications

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Abstract

Unmanned Aerial Systems (UAS) have been used for different applications. Among these applications, most is related to remote sensing, where data is acquired during the flight and processed on ground facilities after flight termination. This work presents the MOSA concept and architecture. MOSA stands for "Mission Oriented Sensor Array". The key idea is to embed all hardware and software necessary to process the raw data collected by the onboard sensors producing real time, ready to use information. This paper aims to present the introductory concepts of the system, under an architectural point of view.

Introduction

UAVs will be predominant in the skies in 10-15 years' time, when they must be as safe as, or even safer, than current manned aircraft. Autonomous flight automation and other common mechanisms must represent a solution, not a problem.

The use of UAVs has become increasingly common, particularly in civilian applications. In the military scenario, the use of UASs has focused on the fulfillment of specific tasks that can be divided into two broad categories: remote sensing and transport of military equipment [1-8].

The main use of these missions is the generation of integrated information from the raw data collected by the onboard sensors. MOSA sensors are intended to provide this information in real time, providing all data processing onboard, minimizing the necessity of high bandwidth communication channels to the ground station.

In this paper, we present an introduction to MOSA systems under an architectural point of view.

The MOSA is an electronic system that integrates several sensors, processing and communication hardware [1]. Its main components are:

- Hardware: modular backplane-based system, configurable with different processing or sensor boards depending on the targeted mission. May include programmable hardware components based on FPGAs (Field Programmable Gate Arrays);
- Software: based on Matlab Simulink Models, making use of a library of basic signal and image processing blocks, using automatic code generation for each hardware processing board;

The main goals of a MOSA system are:

- Real time data processing (or pre-processing), avoiding the transmission of raw data;
- Different applications can run in parallel from the same sensor sources;
- Well defined and standard interface between payload (mission) and aircraft (flight services);
- Interchangeable payloads among different aircraft.

Mission-orientation is related to the following aspects [2]:

- The aircraft is only a mean of transportation for the mission sensors. Additionally to flight services, it can provide communication and locating services for the MOSA system;

- The flight navigation path is provided by the MOSA system that defines most of the flight parameters. The aircraft can, for safety reasons, do not follow the commands of the MOSA system, eventually ending the flight;
- The aircraft can provide flight data for a MOSA system, but the opposite is forbidden for safety;

Figure 1, at the end this paper, illustrates a simplified functional view of the MOSA architecture, showing the main components of the system. To communicate with the aircraft, the MOSA uses an interface named SSP / SSI (Smart Sensor Protocol / Smart Sensor Intertace) [9] as shown in Figure 2. SSP is the data protocol used for communication while SSI is the interface that allows the connection of the two modules.

The MOSA system software must be able to accomplish a mission, processing raw data sensor into ready to use information storing it onboard and sending it through the SSI/SSP communication services. The flight path is controlled by the MOSA sensor using a set of flight services provided by the SSI/SSP.

For most missions, the position of the sensors can be obtained via SSI/SSP from the sensors of the aircraft (inertial/GPS). For more demanding missions, specific sensors must be provided by the MOSA array.

A MOSA array can be composed of different types of sensors, including: GPS INS, Infra-Red, Multi-spectral Cameras, Video, Laser Scan, SAR, Acoustic, etc [1,9,10].

MOSA systems can be used on different aircrafts. The protocol uses plug-and-play mechanisms [9-10]to find if the aircraft is able or not to accomplish a specific mission. A particular task may require a very large range or quick maneuvers, among other limiting factors. The plug and play mechanism must be able to determine whether the planned mission may or may not be performed, completely or partially. An unavailable service may be replaced by an equivalent service and the system reconfigures itself to accomplish the mission.

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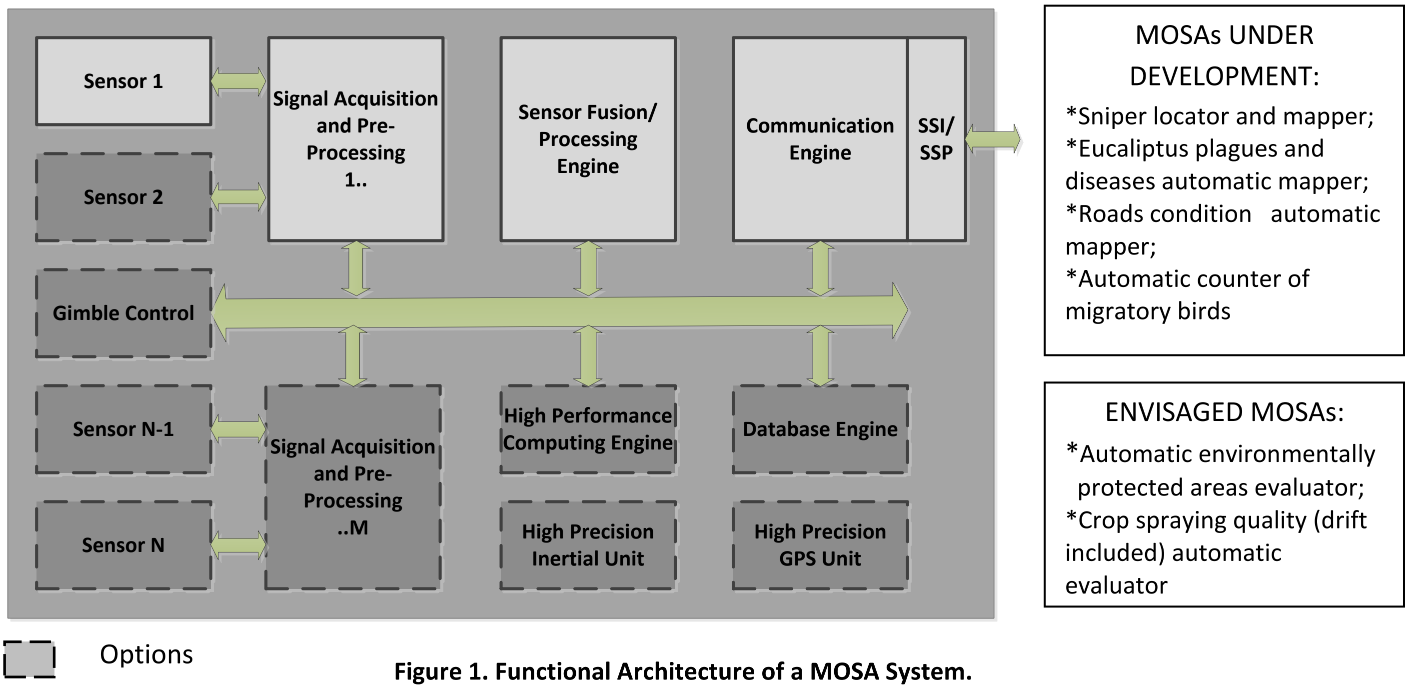

Figure 1. Functional Architecture of a MOSA System.

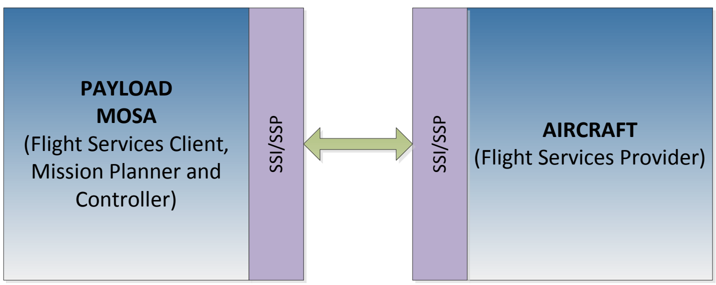

Figure2. Client Server Model of an MOSA Equipped Unmanned Aircraft