

Development of the Open Object-Oriented Autonomous Robotics Kit for Mirco Aerial Vehicles

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Abstract

Closed source autopilot solutions offer a proven system with a well defined set of capabilities. However, limitations in closed source systems hinder the proliferation of micro aerial vehicles (MAV's). First, the per unit cost is prohibitively high. Second, third party development and modification is forbidden. The inability to modify a system and add additional capabilities can be detrimental to research in the dynamic field of unmanned systems.

In this paper, we develop the Open Object-Oriented Autonomous Robotics Kit (OOOARK) with the purpose of enabling rapid unmanned vehicle development. The library abstracts component interaction by defining a common interface to navigation, sensor, guidance, control, and actuator systems. This abstraction facilitates component swapping and addition with minimal effort. The C++ language was chosen for the library due to its large open source code base and its implementation on microprocessors. The OOOARK library is composed of an embedded library for microprocessor tasks (i.e. actuator control) and a standard pc library for non-real-time tasks (i.e. computer vision processing and ground-station interface).

The embedded hardware platform was chosen after evaluating another open source autopilot system, ArduPilot. ArduPilot employs the Atmega 328p from the AVR family of micro-controllers. The ArduPilot board suffers from a lack of communication with only one hardware serial port. In future designs, this will be remedied by upgrading to Atmega 1280 with 4 hardware serial ports. Therefore, we selected the ArduinoMega for our system which also employs the Atmega 1280. The inertial measurement unit used in this design is the 9DOF Razor IMU from Sparkfun electronics. This board has a 3-axis rate gyro, accelerometer, and magnetometer. The ArduImu+ V2 utilized by the ArduPilot project does not have a 3-axis magnetometer which is necessary for indoor navigation applications where attitude information is limited.

We demonstrate the performance of this library and hardware system by flying a fixed-wing MAV outdoors. We also show the results of using stereo-vision cameras mounted on an indoor ground vehicle to detect 3D landscapes which can be used for simultaneous localization and mapping.