RESEARCH MASTER INTERNSHIP

Department of Complex Systems Engineering

Superviser :Jean-Baptiste Chaudron

Duration : 4 to 6 months

Location : Toulouse, campus SUPAERO

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INTERNSHIP DESCRIPTION

Domain : Embedded Systems, Aircraft System and Control

Title : **AIRCRAFT ADIRUS ALGORITHMS EVALUATION**

The aircraft state information fed to the flight control system is measured by sensors of different nature (e.g., accelerometers, gyros, magnetometers). These sensors are generally not perfect and are plagued with bias, drift and noise effects. Therefore, the use of sensors fusion algorithms is key to estimate accurately measured and filtered values and to ensure the correct behavior of the flight controller. In an aircraft, fusion of sensor outputs is the role of ADIRUs (Air Data and Inertial Reference Units) entities.

The most famous algorithm for this usage remains Kalman filter but new algorithms (like Madgwick's or Mahony's) are now also commonly used for UAV attitude estimation. The first goal of this study is to evaluate the use of these algorithms for an aircraft testbed. The baseline for this study will be the Flightgear simulator with JSBSim open source library which provides object classes for flight controller, flight dynamics or non-perfect sensors. The first step of this study will be to extend an existing aircraft simulation with several realistic sensors. Then, the different algorithms for aircraft attitude estimation (mostly based on quaternions) will be compared and the stability of the current flight controller will be assessed. As an iterative process, students will then need to calibrate the different filters gains and the flight controller in order to improve the stability of the aircraft. Different scenarios will be explored.

Moreover, In a real aircraft, the flight control system is non-monolithic system which means that it is distributed over different entities (several distributed computers communicating via a data bus) to ensure same fault tolerance and safety properties. In the same way, the ADIRU entities for sensors fusion are distributed and redundant. Then, as a second step of this study, the working scenarios will have to be migrated over a dedicated distributed architecture (several CPUs connected via an Ethernet network). The fault tolerant properties and the real-time behavior of this architecture would need to be formally validated (under certain assumptions).

Student will have to work closely with the supervisor.

Methods: Distributed computing, Fault tolerance, Functionnal and Temporal Scheduling

20 % Theoretical Research	50 % Applied Research	30 % Experimental Research

Possibility to go on a Ph.D.: o Yes X No

APPLICANT PROFILE

Knowledge and required level: Real-time Computing, C/C++ Programming, Aircraft Control

Langages/Systèmes : C/C++, Linux, Flightgear, JsBSim, Simulink (if needed)

Applications should be sent by e-mail to the supervisor.