Internship and PhD position

Solutions for the design of aircraft integrated ground control laws

Context

Fly-by-wire systems are commonly used on-board transport aircraft, allowing the automation of many parts of the flight, including the landing phase. However, right after touch-down, the motion is still controlled manually by the pilot, who has to coordinate actions on rudder deflection, engine thrust, wheel brakes and nose-wheel steering system. This piloting task is quite demanding, especially in bad weather conditions, and the aircraft behavior on ground significantly changes according to the runway state, which is usually unknown. Moreover, in order to reduce congestion of most big airports, ground phases have to be constantly further optimized. Thus, there are both safety and economic needs to develop new control systems improving aircraft on-ground handling qualities.

One of the main issues is the use of differential braking in conjunction with classical control devices (nose-wheel steering system and rudder) on degraded and unknown runway states. The objectives are to improve maneuverability and piloting ease at low speed, and to ensure safety of operations at high speed. A crucial point is to find a suitable way to share the control action between the various devices according to the aircraft velocity.

Objectives

The proposed PhD project, which has been initiated by Airbus France, falls within this context. The first task will be to provide a state-of-the-art review on aircraft on-ground control, but also to take a look at the automobile domain, where the friction forces between the wheels and the ground have been studied extensively for quite a long time. A methodology will then be developed to address the aforementioned control problem. The work will mainly consist of:

- developing simple but accurate models of the highly nonlinear friction forces,
- investigating the most promising control techniques, such as sliding mode control,
- designing observers to provide a reliable estimation of relevant parameters such as the runway state.

The final objective is to propose a complete control architecture, which can be implemented on a real aircraft.

Application and administrative details

This research activity will mix advanced theoretical research on system identification and control, experimental testing on a realistic testbed, and practical application in an industrial environment. It will start with a six-month internship in Spring and Summer 2016, which will take place in the Systems Control and Flight Dynamics Department of ONERA The French Aerospace Lab, Toulouse, France. The three-year PhD project will then start in October 2016. It will be jointly supervised by Airbus France, ONERA The French Aerospace Lab and Haute Alsace University, with the collaboration of Airbus UK. The PhD student will spend most of his time in Toulouse, but frequent trips are scheduled to Mulhouse, France and Filton, UK. Candidates should have good knowledge in control theory, linear algebra, flight dynamics and Matlab/Simulink software, as well as a very good English level.

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