French-German Research Institute of Saint-Louis

The **French-German Research Institute of Saint-Louis (ISL)** situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network.

The spectrum of our core activities comprises a variety of topics : aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is seeking to fill a

PhD Position
Linear Parameter Varying (LPV) model identification of aerodynamic coefficients based on free flight data

Profile

Master internship
Good background in signals and systems, automatic control and MATLAB
Knowledge in aerodynamics and flight mechanics is not necessary, but is appreciated
The Research Center for Automatic Control of Nancy (CRAN) at University of Lorraine and the French-German Research Institute of Saint-Louis (ISL) announce a vacancy for a three year PhD position to be started in October 2016.

Project description

The use of aerodynamic coefficients for the characterization of the behavior of an object in flight remains one of the oldest and most emergent research projects in the field of exterior ballistics. Currently, there exist complementary methods able to quantify the aerodynamic coefficients of vehicles in flight. Regarded as reference, free flight tests allow the vehicle aerodynamics to be revealed under real experimental conditions and aerodynamic coefficients can be determined from free flight measurements through the use of system identification procedures.

The system identification of a vehicle in free flight consists first in the determination of a model structure and secondly in the estimation of the unknown parameters contained in the chosen model structure. The problem focuses on the latter since the general model structure is assumed to be known. Indeed, the state equations are constructed by taking into account Newton/Euler's laws of a rigid body motion, while the output equations correspond to free flight measurements. More precisely, it is a continuous-time nonlinear state-space model, composed of 12 state variables and seven output signals. The unknown aerodynamic coefficients can be further represented as a function of several state variables, where the parameters describing them are precisely the model parameters to be determined.

The present PhD project intends to improve the accuracy of the estimated aerodynamic coefficients based on onboard and on-ground measurements: radar data, magnetometer and accelerometer measurements, 3D high-speed cameras. For this purpose, the proposed approach aims at constructing a Linear Parameter-Varying (LPV) model derived from the known nonlinear equations describing the behavior of a vehicle in free flight. In that direction, several linearization methods should be benchmarked and the identification of the state-space LPV system investigated.

The candidate will integrate into the ISL Division II (Flight Techniques for Projectiles) ABX (Aerodynamics and eXterior Ballistics) research group and the CID (Control Identification Diagnostic) department at the Research Center for Automatic Control of Nancy (CRAN), University of Lorraine. The PhD subject is funded by ISL, about 2500 €/month.

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