ONERA

THE FRENCH AEROSPACE LAB

Postdoctoral Position

Référence : **PDOC-DAAA-2017-03**

Laboratoire d'accueil à l'ONERA (www.onera.fr) :

Branche : Fluid Mechanics and Energetics **Lieu** (centre ONERA) : LILLE

Département : Aerodynamics, Aeroelasticity, Acoustics (DAAA)

Unité : Experiments and Flight Limit (ELV)

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Subject : Development of machine learning techniques adapted to aircraft stalled flight behavior prediction.

Keywords : Machine learning, Modeling, Aircraft test plan, Simulations, Aerodynamics.

Context :

The conventional approach used by ONERA to predict aircraft spin behavior relies mainly on four stages:

1. Characterization of the aerodynamics of the vehicle by wind tunnel tests or numerical simulations,
2. Development of a model for the aerodynamic torsor by a response surface in the discrete parameter space,
3. Determination of the equilibrium states,
4. Realization of temporal simulations initiated in the vicinity of these equilibrium states in order to define the spin input and output maneuvers.

Offer Description :

The proposed approach consists in starting from a simple pre-established model, which will be enriched by means of learning techniques with the objective of increasing the precision of the reconstruction of the equilibrium branches, especially in the vicinity of the bifurcation points. Reinforcement learning will be considered initially but other techniques will also be tested.

The use of the experimental data in the learning process will lead to determine a numerical model allowing a better prediction of the behavior of the aircraft in stalled flight. This model should have the capacity to take into account the constraints related to the experimental device setup as well as the uncertainties inherent in the measurements and those generated by the specific experimental device.

Key responsabilities

1- Obtaining a robust model for aircraft maneuvering in spinning regime and apply this methodology to other cases; e.g. autonomous drones, ….

2- Obtaining informations about how to enhance the experimental devices by back-processing the model; e.g. introducing new degrees of freedom, ….

Collaborations

- With the TsAGI on the quantitative analysis techniques of the non-linear dynamical system.
- Upcoming PhD thesis on the impact of the representation model accuracy for the prediction of the behavior of the aircraft in stalled flight.
- Participation in the DELTA intra-departmental project at ONERA.

Bibliography

[1] Sutton, R.S. & Barto, A.G. (1998). Reinforcement Learning: An Introduction. The MIT Press Cambridge, MA.

[2] Ng, A and al. (2004). Autonomous helicopter flight via reinforcement learning. In NIPS 16

Type of Contract: Temporary, 12 months, renewable once

Job Status: Full-time

Envisaged Job Starting Date: between 01-Nov-2017 and 01-January-2018

Benefits: Remuneration/year ~25 k€

Required education level : PhD degree in applied mathematics, numerical analysis or Computational Fluids Dynamics.

Skills/Qualifications:

- Machine learning methods. System of ordinary/partial differential equations. Dynamical system. Aerodynamics and Flight dynamics.
- Programming langage (C, C++, Matlab, Python, R, Torch…).
- Good interpersonal and communication skills, be able to work in a multi-cultural environment both independently and as a part of a team.
- Research experience required, with good publication record.