2018-01036 - Engineer Position in Machine Learning applied to aviation (M/F)

Level of qualifications required: Graduate degree or equivalent
Function: Temporary scientific engineer
Level of experience: Recently graduated

About the research centre or Inria department

The Inria Lille - Nord Europe Research Centre was founded in 2008 and employs a staff of 360, including 300 scientists working in sixteen research teams. Recognised for its outstanding contribution to the socio-economic development of the Nord – Pas-de-Calais Region, the Inria Lille - Nord Europe Research Centre undertakes research in the field of computer science in collaboration with a range of academic, institutional and industrial partners.

The strategy of the Centre is to develop an internationally renowned centre of excellence with a significant impact on the City of Lille and its surrounding area. It works to achieve this by pursuing a range of ambitious research projects in such fields of computer science as the intelligence of data and adaptive software systems. Building on the synergies between research and industry, Inria is a major contributor to skills and technology transfer in the field of computer science.

Context

Commercial aviation is already responsible of 3% of the total CO2 emissions, and with a constant growth rate of 5% per year, traffic will double within the next decade. Major improvements have been made in aircraft design and materials, engines performance and efficiency, still aircarrier operations remain unchanged for many years. With the digital transformation of many industries, airline operations have been just at the beginning of a major change. With the support of new technologies related to machine learning and artificial intelligence, in-flight connectivity, major improvements can be introduced to optimize Flight trajectories.

The main objective of PERF-IA is to bring those new technologies to the field of aviation based on statistical analysis of flight data that are generated by aircraft throughout their lifecycle. Currently, aircraft manufacturers, flight management systems and flight preparation software providers are using a single manufacturer’s performance model that is the same for every aircraft of the same type, and also on a weather forecast that is computed long before the flight.

The performance is based on manufacturer’s model that is derived from flight tests conducted on brand new aircraft during certification phase. The only corrections applied to those performance models are made through the fuel or performance factor, that is a single percentage applied to the whole flight, though it is only a measurement made during cruise phase and corresponds to a steady flight. PERF-IA will focus on the challenge of minimizing fuel consumption throughout the flight. The aim will be to provide a flight trajectory optimization prototype that implements new machine learning performance models. Minimizing the fuel consumption can be mathematically modelled as an optimal control problem, whose solution is expected to be as close as possible to the best trajectory in reality. This can only be achieved if the mathematical modelling of the problem is performed as accurately as possible, a requirement for this being the precise estimation of the aircraft’s behaviour. This motivates the search for narrow system identification techniques, which are the main topic of this call. Several new performance models will be identified and tested for this purpose. New techniques will be proposed in order to have the most accurate tool as possible. Moreover, high-level artificial intelligence techniques will use the machine learning models for the objective of the fuel use minimization.

Flexible start date between May 2019 and October 2019.

Assignment

The post holder is expected to start in June 2019 or later. The position comes with health insurance and social benefits, such as subsidised catering service and partially-reimbursed public transport. The project PERF-IA is funded by the European Commission for the period 2018–2020. The post holder will be working within the Modal project-team of the Inria Lille - Nord Europe research center, under the direct supervision of (i) Dr Benjamin Guedj, research scientist at Inria, (ii) Dr Vincent Vandewalle, assistant Professor at Lille University. Inria is the top French research institute in computer science and mathematics, with a particular focus on machine learning and artificial intelligence. Inria is organized in eight research centers. Further info on Inria and its Lille - Nord Europe research center: https://www.inria.fr/en/

Lille, France is a beautiful, historic city conveniently located near Paris, Brussels, and London with excellent train and air connections (50 minutes by high-speed train to CDG international airport), and is renowned for its welcoming living environment. Further info on Lille: https://en.wikipedia.org/wiki/Lille Occasional travels to Safety Line’s offices in downtown Paris are expected.

Safety Line is an innovative digital technology company, specialised in data management software solutions for aviation. With a team of highly experienced Safety experts (including former BEA investigators), data scientists and IT specialists, SL aims to bring their capabilities ranging from flight data recorder raw data decoding and processing, big data analytics to perform flight profile optimization (OptiClimb), and to end IT solutions for airlines operations. https://www.safety-line.fr

Main activities

The engineer will implement the machine learning models defined by the consortium, relying in particular on flight data characteristics (time-dependent data, large correlations between flight parameters, large scale data).
A supervised statistical learning setting (regression model) will be defined since the scalar outcome can be extracted from the data (consumption, aerodynamic forces, etc.).

The engineer will implement in Python a general pipeline to address data assimilation, processing, and machine learning models (including, but not limited to, tree-based ensemble algorithms, Gradient Boosting algorithms, model aggregation, Bayesian and kernel methods). Safety Line will bring an expertise to the flight data and flight mechanics that will support the statistical modelling.

A particular focus will be on the development of an optimization procedure which makes use of the aircraft performance model defined. A reinforcement learning setting with continuous states and actions will be investigated in order to take into account nonparametric performance models. The optimization tools will be adapted to all flight phases (climb, cruise, descent) and a first proof of concept will be implemented.

**Skills**

- Master degree in statistics, machine learning, computer science or related area.
- Working fluency in English. French is also helpful but not required, as international research in the area is typically published and presented in English.
- Ability to read and understand research articles, and implement corresponding algorithms in a Python environment.
- Ability to engage in cooperative teamwork (such as frequent reporting).
- Excellent Python programming skills.

**Benefits package**

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave

**Remuneration**

Compensation according to the profile.