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POSTDOCTORAL POSITION

Référence : **PDOC2015_DCPS-03-SAE**
(à rappeler dans toute correspondance)

Laboratoire d'accueil à l'ONERA

Branche: Traitement de l'Information et Systèmes

Lieu : Toulouse - France

Departement/. :
System Design and Performance evaluation Department

Unit :
Aeronautical Systems Research Unit

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Subject : MultiDisciplinary Optimization for aircraft conceptual design: development of formulations adapted to mixed fidelity approaches

Key words: MDO, Aircraft Design

Context

Because of stringent requirements in terms of fuel consumption, pollutant emission and noise generation, the next generation of aircraft will face many design challenges. As the classical “tubes and wing” configuration has been optimized during the last 50 years, large improvements might be difficult to obtain. Thus, there have been many studies on disruptive aircraft configurations such as strut- braced wing, box-wing or forward swept wing showing potential benefits. However, as these concepts cannot rely on existing data, there is a clear need to improve the design tools with physic base analyses, high fidelity computations and optimization capabilities.

To reach these goals, introducing multidisciplinary design capabilities in processes that are traditionally constructed as a sequence of mono-disciplinary sequences (analysis or optimization), enables to deal with the different disciplines at the same time and to take into account the interactions between them or between the system components.

By handling the various disciplines simultaneously, multidisciplinary optimization capabilities facilitate the search for a global optimal design, which may not be obtained when the disciplines are handled sequentially. Indeed, in most design problems, the various disciplines may lead to antagonistic decisions. In such cases, MDO (MultiDisciplinary Optimization) techniques are aimed at finding compromises between the different disciplines, in order to achieve a robust optimal design.

In 2015, the H2020 EU Project AGILE has been launched to investigate these aspects in details and to successively develop novel aircraft configuration. Within a consortium of 20 partners, Onera is responsible for the MDO formulation study as well as the robust multi-disciplinary approaches. In parallel, the NACOR project proposed within Clean Sky 2 would rely on the techniques development to set-up a Multi-Disciplinary Analysis and Optimization process dedicated to innovative configurations.

Workplan

As member of the research group “Aircraft Design” within the SAE unit (Aeronautics Systems Unit) of ONERA, the candidate will have to develop and implement innovative MDO approaches within a multi-disciplinary process. The work would focus on methodological development and it would support the engineer’s activity in the framework of the AGILE and CS2 NACOR European Projects in

collaboration with EU Aeronautical Research centers (ONERA, DLR, NLR, ..) and Universities (TU Delft, University of Naples, KTH, ..).

More precisely, the following tasks will be carried out:

- Application of previous MDO formulation on an innovative Overall Aircraft Design approach integrating high fidelity tools for radical configuration design. Handling a series of disciplines at the same time significantly increases the complexity of the problem to be solved. The reduction of this complexity will be made possible by applying a problem formulation: decomposing the problem into sub-problems and defining a strategy managing the stages of analysis and optimization of these sub-problems.
- Development of metamodels adapted to the MDO formulations in the context of complex workflow. Even if computers can quickly process large amounts of data, calling a high-fidelity discipline model for the evaluation at all design points in a given large parameter space still remains prohibitive in computational time. The major objective of a surrogate model is to provide accurate low-cost function estimations over the entire parameter space. Once a surrogate model is built, it can be used to replace the high-fidelity model it represents in a discipline workflow with a gain in computational costs. Different surrogate techniques will be investigated (Kriging, Co-Kriging, mixture of experts, ...)
- Investigation of approaches on how to combine different levels of fidelity, with special emphasize on the integration of high fidelity optimization. These developments will be implementing in Onera Overall Aircraft Design code based on the OpenMDAO Framework (http://openmdao.org/).

Duration: 18 months (beginning between September 2015 and December 2015)

Net salary: around 24 000 euros

PROFIL DU CANDIDAT

Qualifications:

Graduate level with aeronautical knowledge, advanced design methods

PhD obtained in

Applied Mathematics (MultiDisciplinary Optimization)

Others:

Fluent English skills, knowledge of Python preferably