Turbomachinery and propulsion Department
Von Karman Institute

Marie Curie Early Stage Researcher (ESR) in **Robust Multidisciplinary Optimisation of Composite Fan Blades**
(Full-time, fixed term for three years, available from 1 February 2013)

This new research position is being funded through the AMEDEO European Commission FP7 Marie Curie Initial Training Network (MC ITN). You will work within the turbomachinery department of the Von Karman Institute (Belgium). You will be a member of a multidisciplinary consortium (with Rolls Royce, UK, Technische Universiteit Delft (TUD), Netherlands, and Koc University, Turkey) working on Robust Multidisciplinary Design Optimisation of composite fan blades. The project will involve an efficient parameterization of the fan blade considering the transonic regime, automatize the evaluation chain comprising of Computational Fluid Dynamics and Computational Structural Mechanics and effectuating a multi-objective optimization of the fan shape including next to traditional aerodynamic requirements also structural (composite) specifications. There will be close collaboration with and secondments to Rolls Royce Derby UK, Technische Universiteit Delft (TUD), Netherlands, and Koc University, Turkey. You will be expected to attend a number of training events delivered by AMEDEO partner organisations.

You will have a 1st or upper second class (or equivalent) undergraduate degree in Engineering, Mathematics or a Physical Science. Research experience gained through an MSc or other higher degree would be advantageous. Excellent interpersonal and communication skills are essential, as is a willingness to work flexibly and travel to collaborating Partners. It is expected that the successful applicant would register for a PhD degree in the University of choice. You will satisfy the Marie Curie ITN eligibility criteria, which are put in place to encourage mobility and the training of early researchers. These are:

- Full time equivalent research experience: maximum of 4 years and do not possess a PhD.
- Researchers can be nationals of any country other than the country of the premises of the host organisation where they will carry out their project (i.e. Belgium). Researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of the host (i.e. Belgium) for more than 12 months in the 3 years immediately prior to their recruitment.

You will also be a European passport holder with permission to work in Belgium and UK.

You will have a Personal Career Development Plan, designed with the supervisors at the beginning of the fellowship, covering training needs (including complementary skills) and scientific objectives. You will have secondments to both Rolls Royce, UK and University of Leeds.

You will satisfy the eligibility requirements for an Early Stage Researcher under the European Commission Framework 7 Early Stage Training Scheme; in particular, they should be eligible to be appointed as an Early Stage Researcher in Belgium - this means:

- Less than four years research experience and must not possess a PhD. This is measured from the date when they obtained the degree which would formally entitle them to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the research training is provided.

- To not be a national of Belgium (there are two exceptions: researchers with more than one nationality can be recruited if they have not resided in Belgium during the previous five years; researchers who have legally resided and have had their principal activity (work, studies, etc) in a third country for at least three out of the last four years).

- To not have resided or carried out their main activity in Belgium for more than twelve months in the three years immediately prior to their recruitment.

For information on Marie Curie initial training networks, see: http://ec.europa.eu/mariecurieactions

Informal enquires to Tom Verstraete, tom.verstraete@vki.ac.be

Closing Date: 15th January 2013

Turbomachinery and propulsion Department

Von Karman Institute

Hours of work: Full Time

Responsible to: Tom Verstraete

Reports to: Tom Verstraete

Job Summary

This new research position is being funded by the European Commission through the AMEDEO FP7 Marie Curie Initial Training Network (MC ITN). You will work in the Von Karman Institue, Belgium.

Background Information

You will be based in the turbomachinery and propulsion department of the von Karman Institute, which priveleges a world-wide recognision in the research and training on turbomachinery. The Turbomachinery and Propulsion department specializes in the aero-thermal aspects of turbomachinery components for aero-engines and industrial gas turbines, space propulsion units, steam turbines and process industry compressors and pumps. It has accumulated skills in wind tunnel testing over a wide range of Mach and Reynolds numbers and related measurement techniques development and application.
The department has acquired a world recognised expertise on steady/unsteady aerodynamic and aero/thermal aspects of high pressure, including cooling, and low pressure turbomachinery components through the design, development and use of a number of unique wind tunnels.
The department has over 20 years of experience in the computational analysis of flow in turbomachines, and in the design techniques and multi-disciplinary optimization methods of their components.

Project Description

Lead Organisation: Von Karman Institute, Collaborators: Rolls Royce, Derby, UK, Technische Universiteit Delft (TUD), Netherlands, and Koc University, Turkey

Purpose:

To achieve higher fuel efficiency, engine manufacturers develop turbofans with higher bypass ratio, which can only be achieved with larger (and heavier) fan sections. This makes weight reduction in fan components a major consideration and becomes a key driver for the use of composite materials in future engines. Design of composite blades is a multidisciplinary problem as the fan performance feature described by one discipline

affects many other performance aspects; e.g. composite blades tend to become thicker than hollow metallic ones in order to meet the structural performance targets but this affects the aerodynamic performance (efficiency). This project will use automated optimization algorithms to maximise the blades' efficiency and minimise mass subject to a number of constraints, including: maximum stress and strain, flutter margin, pressure ratio at the operating point and other flight conditions, stall range, cost, manufacturing considerations, noise-related issues, etc…

Methods:
The work will be accomplished by performing several fan blade optimizations. This is achieved by efficiently parameterizing the fan blade shape, automatizing the evaluation chain including Computational Fluid Dynamics and Computational Structural Mechanics for composite materials and optimizing the shape using efficient mutli-objective optimization algorithms.

Networking and Training: You will benefit from expertise in MDO and High Performance Computing, Turbomachinery and high fidelity CFD and CSM in VKI, Rolls Royce, Technische Universiteit Delft, and Koc University. In addition, strong collaboration with other researchers from the AMEDEO consortium is expected to expose you to other research disciplines and aspects relevant to the project. You will have the opportunity to obtain high level training in a number of complementary skills, providing you with a solid framework in which you will be able to develop the rest of your career, being that in academia or industry.

Main Duties and Responsibilities

Your research will involve working closely with other researchers within AMEDEO. In particular you will:

- Work independently on the designated project within AMEDEO.
- Develop an efficient design parametrisation ensuring inter-disciplinary compatibility.
- Develop an automated evaluation of composite fan blades including Computational Fluid Dynamics and Computational Structural Mechanics.
- Perform multi-objective multidisciplinary design optimization of fan blades.
- Deliver prescribed project objectives on time and within budget.
- Collaborate with other researchers in AMEDEO and within the VKI to build sustainable parternships of mutual benefit and aid the process of dissemination.
- Communicate and provide information to academic and industrial supervisors including the regular attendance at formal supervisory meetings.
- Attend and prepare reports for regular meetings with other members of the grant team, to report progress, agree future work and exchange data/experience.

- Manage aspects of the project and co-ordinate work with other internal and external collaborators.
- Independently identify additional external and internal resources to effectively deliver the project work.
- Ensure good progress is maintained and work is undertaken in a systematic way that is well documented so that data can be shared across the project group.
- Train undergraduate and taught MSc students in areas of similar activity and skills and co-supervise projects in this area.
- Prepare written papers and presentations to disseminate the research findings to both AMEDEO partners, the academic and industrial communities and to the wider public at both national and international level.
- Work effectively and positively as required as a team player on a broad range of activities and related projects within the wider research groupings and the School to help achieve the broader strategic development.
- Participate in public engagement activities.
- Identify other research project opportunities and directions as they arise.
- Uphold and enhance the internationally excellent reputation of the organisations you will be associated with and the independent network of contacts by building collaborations with other academics and external stakeholders.
- Work within and apply the standard operating procedures, health and safety regulations and quality assurance procedures of both the VKI and when on secondment at the project partners and be responsible for the health and safety management of relevant projects and research work.

Person Specification		**Essential / Desirable**
1.	A 1st or upper second class degree (or equivalent) in Engineering, Mathematics or a Physical Science.	**Essential**
2.	Hands-on experience of high fidelity RANS based CFD simulation for turbomachinery problems.	**Essential**
3.	Experience of working in a research environment within an academic or industrial setting.	**Essential**
4.	Evidence of having developed independent research skills including experience of project management.	**Essential**
5.	Demonstrate the ability to work as part of a multidisciplinary team.	**Essential**
6.	Evidence of the ability to document and organise work effectively.	**Essential**
7.	Excellent interpersonal and communication skills with command of the English language.	**Essential**

8.	Willingness to work flexibly, where necessary, to fulfil the needs of the research project, including travel within the UK, Turkey, Netherlands and internationally.	**Essential**
9.	A strong MSc degree from Engineering or Physical Sciences	**Essential**
10.	Knowledge and experience of turbomachinery.	**Essential**
11.	Being Familiar with state of the art optimization techniques used in complex multidisciplinary environments.	**Essential**
12.	Have a good knowledge on structural mechanics and vibrations	**Essential**
13.	Can do approach to problem solving and issue resolution.	**Desirable**
14.	Collaborative approach to work and development of a supportive culture.	**Desirable**
15.	Have published in either peer-review journals or conferences.	**Desirable**

Key Working Relationships

On a day to day basis the researcher will be responsible to Tom Verstraete..

Additional information

Details of the terms and conditions of employment at the von Karman Institute, including information on pensions and benefits, are available on request.

A Criminal Records Disclosure is not required for this position however applicants who have **unspent** convictions must indicate this in their application and must declare the nature of the conviction.

Data Protection

The information you provide in your application will be used to consider your suitability for the post for which you have applied. If your application is not successful the information will be disposed of confidentially after 9 months.