Dear Colleague,

Your institute has been in contact with CERFACS for various projects in the past. CERFACS has always tried to promote European collaborations: one way to do this is European programmes and another one is also exchanges of students.

Every year, we hire students for training sessions (typically for 6 to 8 months) and we would be very happy to consider applications from students you may know and are interested in studying in Toulouse.

The enclosed list presents the topics proposed for 2005. We would appreciate if you pass it to interested students. Many of these topics could be followed by a PhD.

You can also check our open positions on our website (http://www.cerfacs.fr)

We thank you for your help and look forward to hearing from you.

Dr Thierry PONSOT
Project Leader, CFD team

Turbulence Modeling for thermal applications in CFD

INFOMATIONS

Required Education: Last year of aerospace engineering (or related subject) or M.Sc. / DEA with emphasis on computational fluid dynamics

From: as soon as possible

Duration: 5 - 7 months

Context: One field of research activity at CERFACS is the work on turbulence models for thermal applications. This is done in collaboration with other labs within a research project for investigation of the use of CFD in thermal control of confined surfaces. The code ElsA is utilized for this purpose.

ElsA is a state-of-the-art software system offering a powerful set of Fortran and object-oriented C++ libraries for the numerical solution of the compressible 3D Navier-Stokes equations on complex configurations. It is jointly developed by ONERA and CERFACS.

Description: Popular two-equation turbulence models for CFD tend to overpredict turbulence production in flow-stagnation regions. This leads to excessive high levels of turbulent stresses and turbulent heat transfers to the surface.

The candidate will be involved in the development, evaluation and test of eddy viscosity models restricted to produce a realistic production of turbulence in such cases. He or she will analyze the effect of the limiters in aerothermal applications.

The successful candidate should have good programming skills (ideally in C++ and FORTRAN), some experience with numerical methods for CFD and a strong motivation for collaborative development. Depending on the candidate's accomplishments, the work can serve as a basis for a master's thesis (or equivalent).

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Wake Vortex: Investigation of instabilities due to wave propagation in vortices

INFORMATIONS

- Required Education: Master/DEA/Diplomarbeit
- From: End 2004 - Start 2005
- Duration: 6 or 7 months (possibly extended to a PhD thesis)

Context:

The wake of an aircraft is composed of several intense vortices, which may represent a significant danger to any following aircraft as they may cause an upset in roll or downwash. Air traffic control prescribes minimum separation distances between two successive aircraft in order to prevent hazardous wake encounters. The existing classification, which is primarily based on the aircraft weight, reveals to be insufficient and not always representative of the incorporated danger. Knowledge of wake vortex behavior is a key issue for the European aircraft industry. A revision of existing wake vortex regulations may facilitate the introduction of new very large transport aircraft.

Current research efforts aim to gain new knowledge on vortex phenomena, critical in the context of wake turbulence behind civil aircraft, but not sufficiently addressed or understood in previous studies. Many projects have investigated the behaviour of aircraft vortices, aiming at their characterization and the search for means of reducing the associated hazard. Although a lot of information has been gathered, and many progress made in understanding these flows, some central questions remain unanswered, preventing major advances in this domain. They include the precise role of vortex instabilities on wake decay, the effects of engine jets and fuselage wakes, and the influence of ground proximity on wake evolution, relevant to the airport environment.

Description:

The end effects are present in take-off and landing situations, but they are also ever-present in experiments. The acceleration and deceleration of aircraft (models) are known to create sudden modifications of the vortex structure, which can propagate along the vortices in the form of pressure waves and affect initially unperturbed regions. One goal of the work is to analyse and quantify wave propagation phenomena in simplified vortex models. Vortex bursting is another phenomenon, which is not well understood; it results from the interaction of waves propagating on vortices. It is frequently observed in real aircraft wakes. The second goal of the work is to improve the understanding of vortex bursting, and to investigate whether it can be used for enhanced wake decay. Direct numerical simulations will be conducted to analyse and quantify wave propagation phenomena, in particular vortex bursting and end-effects or other abrupt modifications of wake vortices in simplified vortex models.

The code that will be used is called WFMIX3D, which solves the Navier-Stokes equations for a 3D, unsteady, compressible...
CFD : Turbulence modelling for buffet phenomenon with a Detached Eddy Simulation approach

INFORMATIONS

Required Education:
Last year engineer / M.Sc. / DEA / Diplomarbeit

From:
2004

Duration:
5 to 7 months

Context:
In some transonic flow conditions, the shock wave/turbulent boundary layer interaction and flow separation on an aircraft wing, induce aerodynamic flow instabilities called aerodynamic buffet. The buffet loads due to flow separation on the wing may cause serious fatigue problems and have an important impact on the structural integrity of the aircraft. The objective of this work is to simulate this phenomenon with the DES approach.

DES is a recent technique, devised to predict separated flows at high Reynolds numbers with a manageable cost which is not possible neither with the Large-Eddy Simulation (unaffordable in the thin regions of the boundary layer), nor with Reynolds- Averaged Navier-Stokes models (insufficient accuracy in regions of massive separation).

Description:
The purpose of this work is to realize a Detached Eddy Simulation (DES) around a 2,50 wing with a library called elsA (see http://elsa.onera.fr). This library solves the 3D Navier-Stokes equations using a finite-volume multi-blocks compressible approach. There is an important effort to determine and build an efficient grid to get satisfactory results.

The candidate should have:
- a good knowledge in CFD
- a good knowledge of meshing tools
- programming skills (C++ is a plus)
- a strong motivation

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CFD : Evaluation of elsA in turbomachinery application

INFORMATIONS

Required Education:
Last year engineer / M.Sc. / DEA / Diplomarbeit

From:
2004

Duration:
5 to 7 months

Context:
Since many years, CERFACS is involved in the development of a CFD library called elsA (see http://elsa.onera.fr). This library solves the 3D Navier-Stokes equations using a finite-volume multi-blocks compressible approach. In the framework of the EXTERNAL aeronautical, elsA has been intensively tested and an airplane manufacturer is going to use it as a standard tool at the end of this year (2003).

Now, we are interested to use this library as an industrial tool for turbomachinery applications. Accordingly, we need to evaluate elsA for such applications and determine the optimum numerical parameters for accuracy, robustness and efficiency.

Description:
The purpose of this work is to compute series of test cases (simplified geometry representative of a turbine) in order to select and order relevant numerical parameters (turbulence model, boundary condition, etc.). These numerical parameters will be study more deeply and improve if possible. These parametric studies should permit to extract the better numerical methods for turbomachinery applications.

The candidate should have:
- a good knowledge in CFD (turbomachinery experience is a plus)
- a strong motivation
- a good programming skills (C++ is a plus)
LES of turbulent two-phase combustion

INFORMATIONS
Niveau requis: Engineering diploma or DEA
Date de début: February 2005
Durée: 6 months
Contenu: CERFACS has been developing for several years a LES tool (AVVP) for the computation of industrial combustion chambers. This two-phase flow module is still in development, and needs improvements on the modeling aspects as well as the numerical aspects. The main applications are the gas turbines combustion chambers, in collaboration with our partner AEREMA.
Description: The objective is to contribute to the development of the AVVP code, a finite volume code solving for turbulent compressible reactive two-phase flows on unstructured meshes, with LES turbulence modeling. The proposed work is the computation of a series of test cases, the development of specific models, their implementation in the code and their validation. The final objective is to compute an industrial combustion chamber on a complex geometry, with spray combustion and turbulence.

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Large Eddy Simulations of combustion instabilities in gas turbines

INFORMATIONS
Required: DEA or Diplomarbeit (foreign applications welcome)
Education: 2005
Duration: 5 to 8 months
Contenu: Large Eddy Simulations (LES) are one of the only tools able to predict combustion oscillations in gas turbines. This critical problem, both for aero and industrial gas turbines is a limiting factor in the development of many present projects and is the topic of multiple bilateral and European projects. CERFACS is leading research in this field (see www.cerfacs.fr/cfd) and develop a LES tool to be used in aero turbines (for SNAREA or TURBONEA) and industrial turbines (for ALSTOM or SIEMENS). This ambitious project gathers experts in applied math, fluid mechanics and combustion. It also requires intense collaboration with academic labs all over Europe.
Description: The student (french DEA or equivalent) will:
- study turbulent combustion and combustion instabilities
- study the basis of LES methods
- perform computations of basic cases where results are available
- perform computations in a Siemens burner and/or in a Turbowright burner. These full 3D simulations will be performed on large parallel computers. The aim will be to predict the cold and the reacting flow in the burner and study its stability.
All studies will be covered by European projects or industrial contracts but will contain a large amount of academic work

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Toutes les annonces de stages ou d'emplois sont consultables à http://asx.cerfacs.fr/Open_Positions/index_stage.html