TMEX02 - Optimization of jet engine blade aerodynamics

We are looking for a team of six students, Fig 1a, interested in improving the aerodynamic design of a jet engine turbine. A strong Swedish industrial interest exists for designing and improving turbine aerodynamics in general and turbine outlet guide vane performance (OGV), see Fig. 1b, in particular. The division of fluid dynamics at the department of applied mechanics has access both to software for simulation and optimization as well as rigs for testing new designs, as illustrated in Fig. 1c.

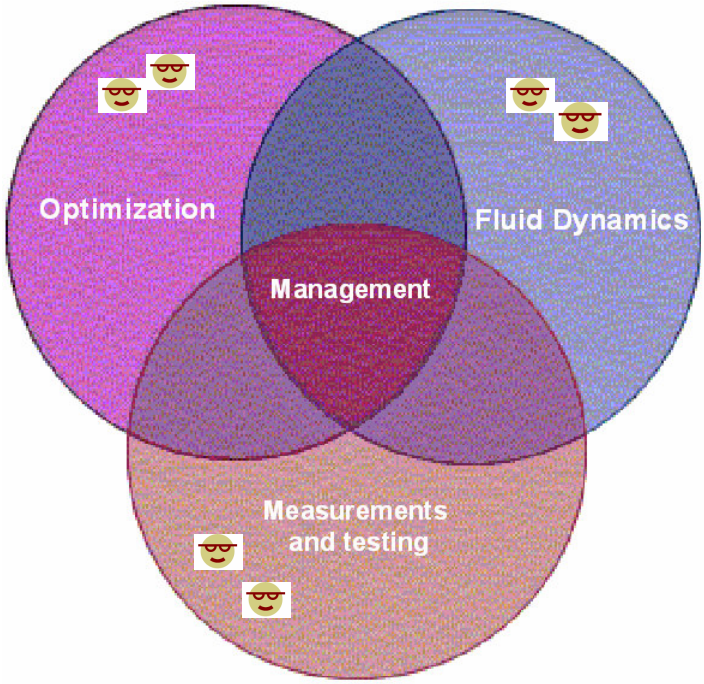

Fig 1a

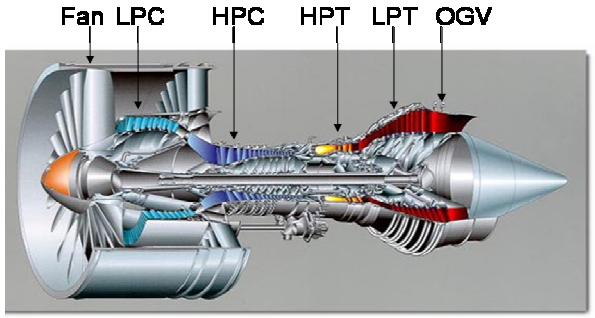

Fig 1b

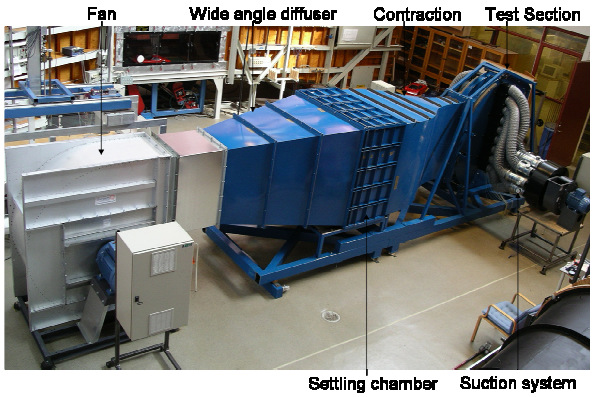

Fig 1c

Fig. 1 – team configuration, turbine outlet guide vane location in engine and engine test rig.

The task consists of improving the aerodynamic design of an Ogv blade, by optimizing its shape as well as to supervise its manufacturing and testing. The team will consist of four interacting subgroups:

- Aerodynamics (two students)
  - Fields of learning: CFD and fluid dynamics.
  - Main tasks: Simulate fluid flow. Understand flow physics.
- Optimization (two students)
  - Fields of learning: CFD and optimization theory.
  - Main tasks: Determine optimal turbine blading.

- Fluid measurements and testing (two students)
    - Fields of learning: Turbomachinery and measurement techniques
    - Main tasks: Perform measurements and communicate results. Understand the jet engine turbine blade performance. Test nominal and improved blading.
- Project lead and management (take turns on this role)
    - Fields of learning: Project coordination as well as covering CFD/Fluid/Dynamics/Optimization/Turbomachinery as needed to communicate results.
    - Tasks: Develop project plan and work with sponsors to negotiate manufacturing deal. Responsible for coordinating analysis.

The breakdown into subgroups is necessary to allow individual evaluation of the student efforts and to establish clear responsibilities within the team.

The project is directed towards students at the M-programme, but also students at the F, K and Kf programmes are invited to apply. Prerequisite for the project is that the students have passed a fluid mechanics course or a course in transport processes (MTF052, TME055, KAA060).

Although the participants will choose particular roles in the project, it is also the intent to make some interchange of these in order to share experience and exchanges knowledge. It is the intent that the project lead role will be occupied at least for a shorter period of time by all the students.

Industrial partners: Caran, Volvo Aero

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Future opportunities:
Annular cascade flow physics may be studied in a rig currently being manufactured at the department. Blade optimization targets may vary. Geometry parameterization can be made more sophisticated in the future to allow automatic optimization.

Pedagogic concept: CDIO.