TOWARDS CONCURRENT MULTI-DISCIPLINARY DESIGN AND OPTIMIZATION

H. Deconinck, T. Verstraete and T. Quintino

Von Karman Institute for Fluid Dynamics, Sint-Genesius-Rode, Belgium

ABSTRACT

Design tools based on Computational Fluid Dynamics (CFD) and Computational Structural Mechanics (CSM) have introduced a change in design philosophy of many companies. The ability to test a design virtually on the computer before it is built indeed allows improved designs from many perspectives.

However, many designs require a multi-disciplinary approach, which is often achieved by an iterative exchange between different departments. For example, in a traditional turbine blade design the blade is first designed and optimized by the aerodynamic department before being passed to the structural department. If from a structural point of view the blade does not meet the requested targets, it is send back to the aero design with some restrictions on the design space. Many iterations between the different departments may be needed before a compromise is found.

On the other hand, in a concurrent approach, all disciplines are evaluated at the same time, and modifications to the design are made based on a global view of its performance in the different fields. This approach allows eliminating the time-consuming iterations between different departments and reduces the design cost. Moreover, the direct interaction between the different disciplines results often in innovative designs that would not have been obtained by traditional design approaches.
This paper will focus on a concurrent multi-disciplinary optimization tool that is used on a daily basis for the design of turbomachinery components. Examples include the design of internal cooling channels in a turbine blade and the design of a centrifugal compressor for a micro gas turbine.

Also the collaborative software environment in which such interdisciplinary simulations can be integrated and tightly coupled, will be discussed. Such an environment has to satisfy several requirements: the coupling of different physics and numerical techniques requires the creation of proper interfaces between each methodology, and common standards e.g. for multi-domain data storage and (parallel) handling. Modularity, reusability and flexible Intellectual Property Rights (IPR) management are necessary.