CROSS-SOLVER CLOUD-BASED TOOL FOR AERONAUTICAL FSI APPLICATIONS

THE CHALLENGE

The aeronautical sector is very competitive and so the industries need to address very challenging issues in terms of performance and reliability of aircrafts and their components. Within this framework, designers are constantly urged to invest in innovative technologies to enable manufacturers to reduce aircraft development costs and delivery times. To that purpose, during the last three decades, the use of computer-aided engineering (CAE) techniques, based on computational fluid dynamics (CFD) and computational structural mechanics (CSM), has become common practice in conceptual aircraft design thanks to the level of accuracy and reliability achieved by numerical simulations.
Nevertheless, the accomplishment of advanced multi-physics studies through high-fidelity numerical methods, such as fluid-structure interaction (FSI) analyses in a multi-objective optimization (MOO) computing framework, is still really expensive mainly because of hardware (HW), licenses and maintenance related costs as well as high skills required. Given the rather limited engineering budget of several companies, more and more the aircraft design has to be both effective and efficient.

THE SOLUTION

The proposed application experiment aims at solving a wide range of real world aeronautical aero-elastic optimizations in a reliable and cost-efficient way by means of the RBF4AERO software platform running as a cloud-based tool on the high-performance computing (HPC) infrastructure of Fortissimo. Users will be provided with a GUI client that runs on the user's workstation and connects seamlessly to the HPC system to run simulations and optimizations.

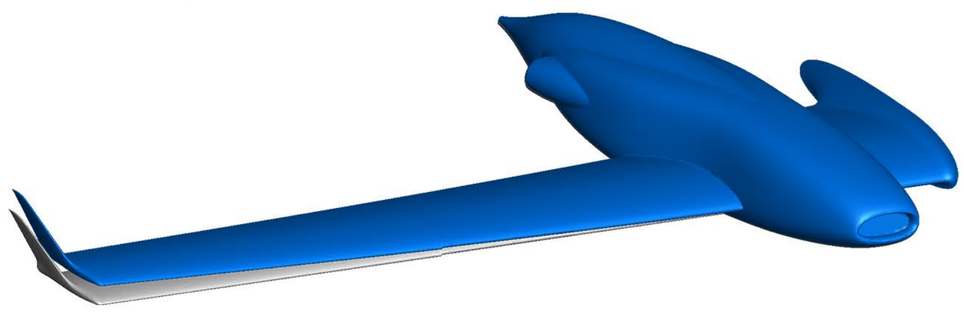
In such a scenario of modern aeronautical design characterized by contrasting needs of speed (time required to complete computing), accuracy (high-fidelity numerical models) and extent (different configurations tested), the solution developed during the RBF4AERO project (www.rbf4aero.eu) has already proven to effectively address such challenging objectives, permitting designers to considerably shorten the time needed to finalise CAE analyses as well as to improve aircraft and its components performances. The key elements of the platform are tools that existed prior to the RBF4ERO project, which have been improved and suitably integrated in a single working environment during its duration. The basic idea of the platform functioning is to make the CAE model parametric through a meshless morphing technique based on radial basis functions (RBF). Such a method allows the user to enable cross-solver applications concerning FSI (according to two-way and mode-superposition approaches), ice accretion simulation as well as optimizations based on the use of evolutionary algorithm (EA) assisted by off-line trained surrogate evaluation models (metamodels) and adjoint-morphing coupling (both stochastic and gradient-based).

THE BENEFITS

By using Fortissimo the possible target market was estimated to be worth 2 billion, 3 year after project completion and to grow annually at least 23% rate. That forecast is based on the following figures:

Civil aeronautics global market turnover was 113 billion € in 2015 with a 23% annual increase.
Current global spend on engineering services (865 billion € in 2012) is expected to reach 1.1 trillion € by 2020. It is also estimated that industrial companies in the aeronautical sector outsource about 30% of their turnover in CAE engineering services.
In the mid-term, D'Appolonia and the Consortium aim at extending the target market to other sectors, exploiting the cross-sectorial nature of RBF4AERO proposed solutions for design optimization (automotive, energy, space, medical, oil and gas sectors are planned to be approached).

The project features represent all factors in the value chain necessary for the realisation of services meeting the end-users' engineering needs as Software-as-a-Services (SaaS). These services are based on the use of HPC "on-demand" resources, already offered within the Fortissimo infrastructure by CINECA. This will enable the use of "off-the-shelves" technologies to address the needs of engineering SMEs which are not able to access such resources. The following table shows some details of the exploitation plan foreseen by each partner.



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