Southampton Partnership Optimizes Collaboration

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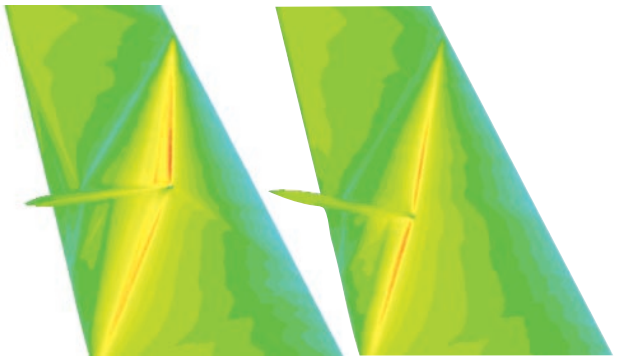


Poor (left) and improved (right) designs for a flap track fairing

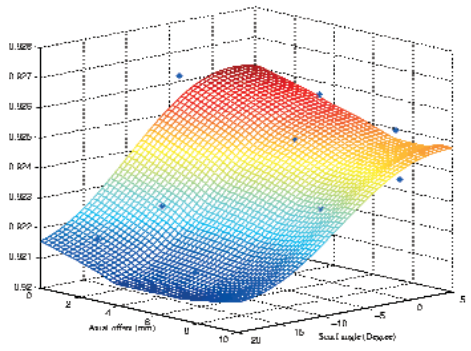
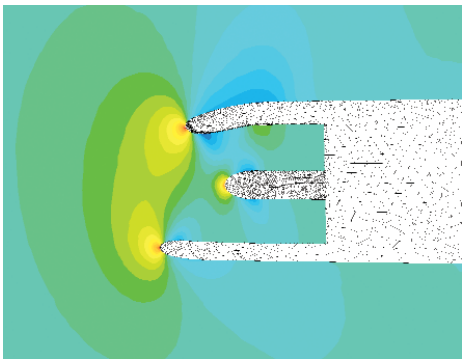


Illustration of a response surface for the scarf angle optimization of a nacelle (top) with pressure coefficient contours (bottom)



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Southampton Computational Engineering and Design group:
www.ses.soton.ac.uk/projects/Comp_Eng_Des/comp_eng_des.html

The Southampton Regional e-Science Centre:
www.e-science.soton.ac.uk

The Geodise Project:
www.geodise.org

Southampton University's School of Engineering Sciences is home to the Computational Engineering and Design (CED) group, which uses FLUENT extensively in a number of academic research projects. The group has an international reputation in the field of multi-disciplinary design optimization, and hosts the University Technology Partnership for design supported by Rolls-Royce and BAE Systems. The industrial partners are eager for the CED group to use an industry standard code like FLUENT for optimization of aerodynamic performance and geometry.

One important project undertaken by the group was the development of an automated design environment to exploit a heterogeneous mixture of local and remote computing facilities. Template files are used to drive CAD-based parametric geometry definition (e.g. CATIA, ICAD, Pro/ENGINEER, IDEAS), mesh generation (GAMBIT) and CFD solutions (FLUENT). In a typical application for the aerospace industry, for example, the system has been used to optimize the shape and orientation of the flap-track fairing on a commercial aircraft wing, which houses the mechanism used to deploy the trailing edge flaps.

Because the group has strong links with industry, it concentrates on methods that combine flexibility with robustness and efficiency. The design search and optimization strategies under investigation by the group attempt to deal with the computationally intensive nature of CFD in a number of ways:

- Application of enhanced response surface methods
- Use of partially converged CFD solutions to build accurate response surface models in a fraction of the time required for full convergence
- Data fusion to combine low and high fidelity CFD data
- CFD mesh morphing to progress rapidly towards optimum geometry

The work in these areas continues, but the methods under development show considerable potential for improving the speed with which design optimization based on CFD can progress.

In recognition of its expertise, the group has been awarded funds to host one of the UK regional e-Science centers, which is tasked with the promotion and development of a distributed computing infrastructure at both local and national levels. One of the supported projects is called GEODISE (Global Engineering Optimization and Design Search for Engineering). The project activities include the use of FLUENT to optimize the scarf angle of the inlet face of an aero-engine nacelle, making the compromise between ground noise levels and aerodynamic performance. The optimization strategy combines a design of experiment (DOE) study with response surface modeling. The experience gained in using FLUENT in aircraft optimization projects is now being extended to a broader range of applications. Racing car components, curved diffusers, river bank erosion, and the influence of bio-geometry on arterial disease all form the subjects of current research projects within the group. Southampton University demonstrates once again the power of FLUENT as a tool for the academic researcher. ■

references:

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