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## UK Applied Aerodynamics Consortium (UKAAC) established

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Computational aerodynamics is a pace setter for the use of major computational facilities in the US and worldwide. It has been estimated that around half of the CPU time used on Department of Defence supercomputers is for aerodynamic studies, contributing to current and future aircraft projects in areas such as flow control, the high angle of attack regime, and design of re-entry vehicles. Research problems in aerodynamics range from fundamental investigations of turbulent flows using Direct Numerical Simulation and Large Eddy Simulation, through to multi-disciplinary analyses of real aircraft configurations at high Reynolds number. The former has been well represented on UK academic supercomputers for a number of years but the latter has been noticeably absent, despite a healthy research community and a clear demand for computational resources.

This situation led to the formation of the UK Applied Aerodynamics Consortium (UKAAC), which started on HPCx in June 2004 (GR/S91130/01). The consortium involves the Collaborative Computational Project 12 (CCP12), with 12 academic institutions and four industrial partners (BAE SYSTEMS, Rolls Royce, Westland Helicopters and Fluent Europe) whose work is split into themes for helicopters, flexible airframes, engine aeroelastics, vertical landing, and engine-air systems. A significant proportion of the work is aligned with research funded by the Defence and Aerospace Research Partnerships (DARPs)



Figure 2: Hawk flutter simulation (provided by Glasgow University)

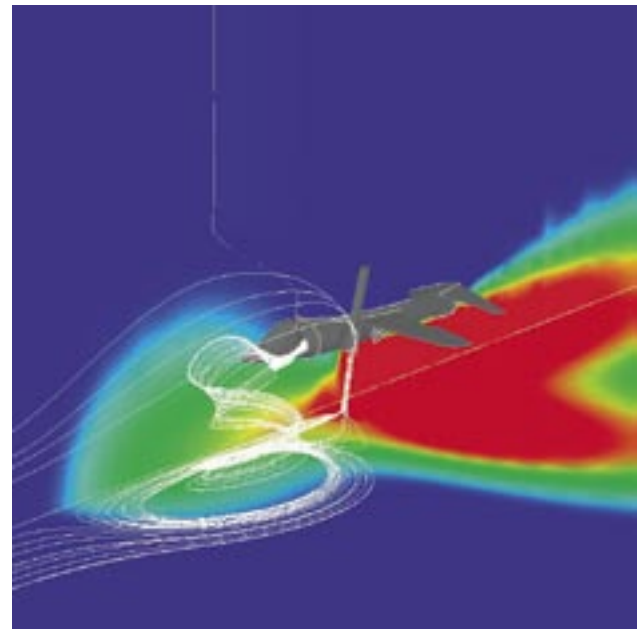


Figure 1: Flow into the intake of a Harrier (provided by Cambridge University).

for Rotorcraft Aeromechanics and Unsteady Flows (PUMA: the Progress in Unsteady Modelling of Aerodynamics program).

One target application is the simulation of a vertical landing aircraft, featuring complex geometry, complex, unsteady flow physics due to jet impingement, and a moving mesh as the aircraft descends. A number of research questions are currently being dealt with in the PUMA DARP to provide the methods required. Current simulations on idealised problems, as shown in figure 1, requires several weeks of processing on local HPC facilities. The target of simulating a full aircraft geometry will require an order of magnitude increase in the number of grid points, making this a capability calculation on HPCx.

A further target application is the simulation of fluid-structure interaction, demonstrated on the Hawk aircraft (figure 2). This simulation couples the structural deformations predicted by a finite element model with a CFD simulation of the aerodynamics. At present the aerodynamic simulations have been limited to inviscid flows but there are many potential problems concerned with phenomena requiring turbulent effects to be incorporated. Again, these are capability calculations on HPCx.

The successful development and demonstration of mature methods for these sorts of problems can have a major influence on the way that aircraft are designed in the future and on the benefits of HPC to industrially-relevant problems. The UKAAC community will be making significant advances on current state-of-the-art simulations and providing demonstrators that will re-establish applied aerodynamics as a key UK HPC activity.

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