Predicting aircraft jet noise

Aircraft noise is a major concern in modern societies and can have strong negative health and economic impacts. Researchers at the University of Loughborough have used ARCHER to develop an interface to improve simulations used to predict aircraft noise.

The world's civil aircraft fleet almost doubles in size every 20 years, and the noise generated by these aircraft is having an unprecedented impact on communities. Plans to expand major airports will further exacerbate this problem if noise emissions are not significantly tackled. To meet the FlightPath 2050 targets set out by ACARE (Advisory Council for Aviation Research and innovation in Europe)[1], the perceived noise emission from flying aircraft in 2050 needs to be reduced by 65% relative to the capabilities of typical new aircraft in 2000.

In recent years, advances in High Performance Computing (HPC) methods have led to encouraging progress in research into jet noise, and computational modelling of simple jets in isolation shows promising results. However, more work is needed to understand the more complex conditions of jets located on moving aircraft, where jet streams interact with the aircraft wing, flaps and pylon, causing sound waves to reflect and scatter.

[1] https://www.acare4europe.org/sria/flightpath-2050-goals/protecting-environment-and-energy-supply-0

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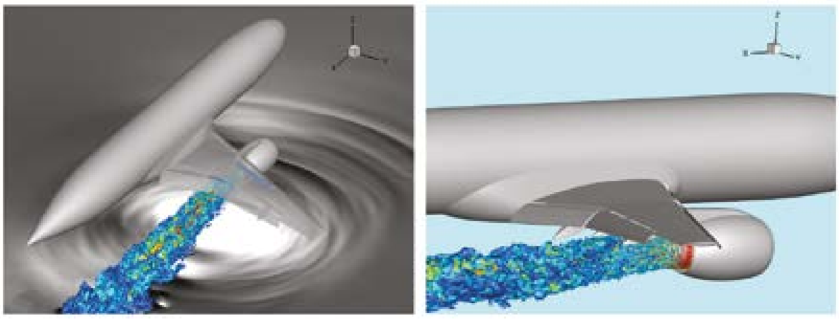

Jet wing/ ap/pylon interaction

Recent research at the University of Loughborough specifically targeted a computational issue that had previously hindered the efficient modelling of sound waves leaving the turbulent jet stream. This research made use of the latest high- end parallel computing techniques to ensure that massive amounts of data could be exchanged in a way that was as parallel – and hence time-efficient – as possible.

Compared to previous simulations, the simulations resulting from this work are 10 times faster for small problems and 100 times faster for larger problems. This has given the research community a new and much more efficient tool with which to model and predict the propagated far-field noise emitted from turbulent jets.

The open-source implementation of this work will also benefit other research fields that rely on high-end computing to tackle multi-physics problems.

Reference:

A fast coupling interface for a high-order acoustic perturbation equations solver with finite volume CFD codes to predict complex jet noise: **https://www.archer.ac.uk/community/eCSE/eCSE12-20/eCSE12-20.php**

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About ARCHER2

ARCHER2 is the UK's National Supercomputing Service, a world class advanced computing resource for UK researchers. ARCHER2 is provided by UKRI, EPCC, Cray (an HPE company) and the University of Edinburgh.

ARCHER2 is the latest in a series of National Supercomputing Services provided to UK researchers. This service will replace ARCHER, the current National System. The simulations in this case study were carried out on the ARCHER system.
See: **www.archer.ac.uk**

The eCSE Programme

The Embedded CSE (eCSE) programme provides funding to the ARCHER2 user community to develop software in a sustainable manner to run on ARCHER2. Funding enables the employment of a researcher or code developer to work specifically on the relevant software to enable new features or improve the performance of the code.