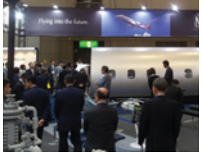

Japan International Aerospace 2012
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DESIGN **DAN THISDELL** LONDON

A350 team gets first look at 'de-risking' software

Humans are pretty good at visualising what will happen if they change one part of a simple system but when that change impacts a large number of outcomes, it takes a computer to work out all the effects.

Engineering consultancy Frazer-Nash believes a software tool it has developed in collaboration with Airbus and EADS Innovation Works addresses this problem, and will help engineers figure out early in the design process which key parameters need to be fixed, and which ones can be dealt with later.

Frazer-Nash aerospace business manager Glyn Norris says the tool is meant to shorten design times by helping engineers make the judgement calls that define the basic configuration of a design at the concept stage. That is, he says, to help answer the question, "what would happen if we changed X?".

Frazer-Nash developed the visualisation capability around statistical data from its partners at EADS, and the system is being used by designers working on the Airbus A350 landing gear. However, Norris says the tool could be used on just about any part of an aircraft, or indeed any complex industrial design.

Later in an aircraft's life it should also be useful, he adds. The same sort of "what if" questions arise when considering the feasibility and cost of, say, stretching an aircraft to accommodate more payload or altering a wing or attempting other aerodynamic improvements.

Ultimately, says Norris, the idea is to "de-risk" the design process by ensuring the important and expensive parameters are established early, so that later work deals with relatively minor challenges of optimisation. ■

For more information on the Airbus A350 design effort, visit **flightglobal.com/a350**

MODELLING **DAN THISDELL** LONDON

The end of the line for linear design

UK research team aims to give engineers a tool for better predicting the dynamic behaviour of complex systems

Engineers typically design mechanical systems to perform through their operating ranges according to well-understood mathematical rules that are clearly established from the relatively narrow range of conditions that it is possible to test in the laboratory or, for aircraft, on the ground.

But while such linear design concepts have formed the basis for the aircraft and components underpinning today's aerospace industry, to make great leaps forward in such areas as aerodynamic efficiency and noise will require engineers to tackle the apparently chaotic non-linear design challenges that characterise much real-world performance.

To bridge the gap to that non-linear world, a team of University of Bristol and allied researchers is setting out to develop the a new set of mathematical tools for engineers, armed with a £4.2 million ($6.7 million), five-year grant from the UK government's Engineering and Physical Sciences Research Council.

Project leader and Bristol professor of structural dynamics Dr David Wagg says non-linearity creeps into a wide range of systems, from compressor blades or the interaction between rotor blades and vibration in a helicopter's fuselage, to wind or wave power generation equipment and long bridges. The Millennium footbridge over London's Thames is one example of a system which turned out to be so sensitive to vibration as to defy linear analysis – thus requiring extensive re-engineering to achieve stability.

Rex Features

He can feel non-linearity creeping in

At a much smaller scale, some medical devices are susceptible to non-linear performance variations – cochlear ear implants, for example, are very sensitive to vibration. Directly relevant to aerospace, modelling the dynamics of rotating components, Wagg says, "is still a big challenge".

The common factor linking all of these challenges, says Wagg, is that they operate in a dynamic environment. But while engineers have many mathematical tools for modelling linear systems, non-linear performance remains so difficult to model that designers almost always choose to avoid non-linearity.

PERFORMANCE TARGETS

To put it another way, says Wagg: "The complexity of modern designs has outstripped our ability to fully understand their dynamic behaviour." And that, he says, is no longer good enough if we hope to achieve some of the performance targets being set for next-generation aircraft. So, to make it easier to introduce radical designs into aircraft Wagg – working with colleagues at Cambridge, Sheffield, Southampton and Swansea universities, and industrial partners including Airbus and AgustaWestland – wants to develop better tools for engineers to model complex systems, and even exploit non-linear effects.

Without better models, says Wagg, some seemingly simple engineering problems are becoming difficult to resolve. How, for example, can an engineer know where or whether weight can be stripped from a component or a new material be introduced if the dynamic behaviour of the system cannot be accurately forecast? To design a wind turbine structure that is safe, reliable and efficient, for example, is an increasingly urgent but far from simple task.

Wagg believes that in six months to two years the team may be able to realise some useful improvements in models already in use by their industrial partners. However, to develop the sort of non-linear system modelling tools the project is aiming for will take the full five years.

A commercially-valuable result, though, could be a five- to 10-year project. ■