News from the European Windtunnel Association NoE

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EWANEWS

Spotlight on QinetiQ
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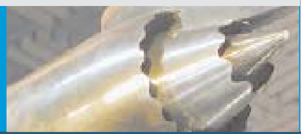


Update

Advanced Validation Technologies 2nd Workshop.

The validation of CFD methods continues to be critically dependent on high quality wind tunnel data. This annual workshop aims to bring together scientists working in either of these fields.

The second workshop in the series was an EWA DESider activity. DESider is an EU funded project, Detached Eddy Simulations for Industrial Aerodynamics, aimed at validating, improving and developing methods in the field of hybrid RANS-LES methods. The workshop was held over two days with the first day hosted by Saab in Linköping and the second day hosted at the FOI wind tunnel site in Bromma, near Stockholm, Sweden.

The scientific programme included three invited speakers, four sessions and a round table discussion. The invited speakers presented different viewpoints on the balance between experiments and numerical calculations.

Noise production, vortex shedding and laminar to turbulent boundary layer transition were given as examples of flow phenomena that are not fully understood and consequently cannot be modelled with confidence.

Several presentations dealt with numerical methods in aeronautical applications. The aerodynamic coefficients of a schematic UAV were derived using an Euler code. The result was judged as reasonable, except in the transonic regime. Further presentations dealt with methods to separate the influence of the wind tunnel from the measured aerodynamic coefficients.

Applications of aeronautical interest are often characterized by high Reynolds numbers, turbulence, wall shear and separation. Presentations were given on various CFD techniques to handle such flows.

The sessions were concluded with round table discussions, where the chairman had prepared some thought provoking questions.

He started by asking the audience "Which are the most important advances in CFD and wind tunnel testing techniques respectively during the last five years?"

After some lively debate the question was posed: "When will it be possible to predict CL-max?" Although it was generally agreed that one day CFD will succeed in predicting CL-max, the question of the time scale remained open.
A short visit to the wind tunnels was on the programme before the bus took delegates to the airport.

Copies of the presentations given at the workshop are available on the EWA web site.

Progress

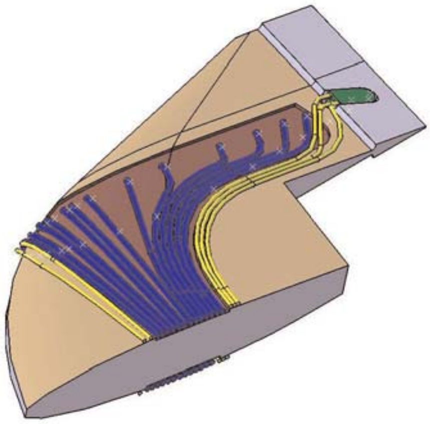
Task 2.2 - Advanced Model Manufacture

Innovative pressure plotting

A project on innovative pressure plotting was launched by ONERA, supported by Airbus-France. The challenge was to achieve a very dense pattern of some 100 pressure taps on a representative horizontal tail plane of a cryogenic model. The model part, being suitable (preferably) for cryogenic testing, was to have its pressure instrumentation below the skin surface, thus allowing a perfect finish. On top of this, the method should save cost and time as compared with conventional techniques.

The basic idea was to mill the steel tail plane some 1.5 millimeters below the nominal contour in the areas where the pressure tubing was to be installed, spot weld the steel pressure tubes in the correct position, cover the assembly with a solid layer (some 2 millimeters) of copper (electrolytic deposit), and mill and hand finish the copper covered stabilizer down to its nominal geometry. Finally, the pressure taps were to be drilled at the correct positions where the pressure tubes were known to be located.

Design and manufacture of the resulting item required assessment and optimisation of various techniques, but the end results were very promising. It was proven that this innovative technique of pressure plotting could be done successfully and with a time saving of some 30%!



Basic pressure plotting technique

The final product

Remotely controlled model parts

Since model configuration changes usually require significant non-productive wind tunnel time, there is a large time and cost saving potential in remote control systems for model parts. Control surfaces are one of the main areas that would benefit and to this end two projects were launched on remotely controlled model parts.

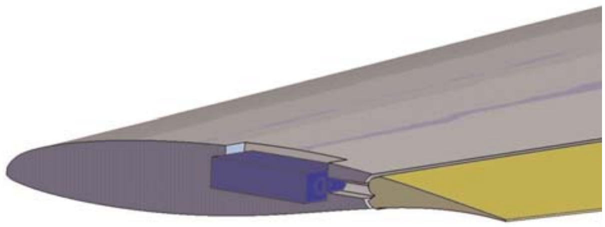
The first project focuses on a remotely controlled aileron drive system for a transonic model of ARA TWT or DNW HST size. The second of the two projects focuses on a non-contact position measuring system for the same aileron.

Model design specialists from NLR, DLR and ARA performed the projects, each producing their own design concept, in competition with the others.

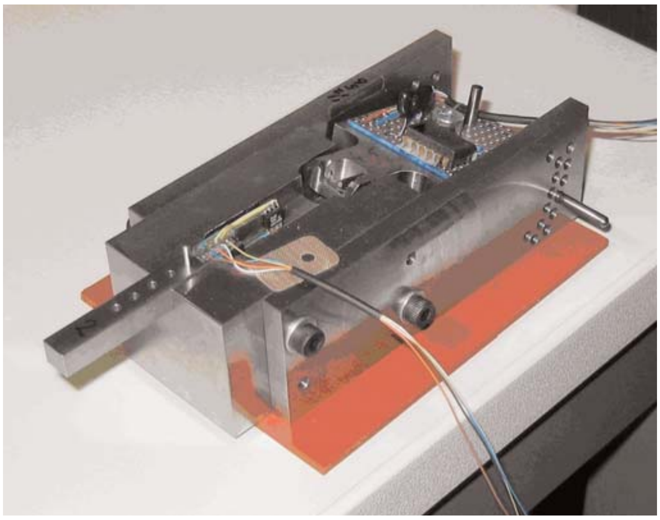
This has resulted in some very surprising and novel ideas of which the feasibility is still to be proven by building and testing representative demonstrators. These demonstrator phases have been planned for 2007.

For the aileron drive system, no selection for the demonstrator phase has been made as yet, as more study on the system characteristics is still required.

For the non-contact measuring system two different types were selected for the demonstrator phase, one based on an optical sensor, the other based on a magnetic sensor. Initial scheming and development tests have been promising.



Scheming for the optical sensor



Test set-up for the magnetic sensor

Further information about these projects can be found on the EWA web site.

Spotlight on QinetiQ

QinetiQ has its origins in the non-nuclear defence research laboratories of the UK Ministry of Defence (MOD); ARE (Admiralty Research Establishment), RAE (Royal Aerospace Establishment), RARDE (Royal Armament Research and Development Establishment) and RSRE (Royal Signals and Radar Establishment). It can thus trace its heritage from the birth of powered flight in the UK at Farnborough, through the development of radar at Malvern during the Second World War to inventions such as thermal imaging, carbon fibre, liquid crystal displays and internet technologies during the Cold War years.

In 1991, the UK government placed these laboratories into an executive agency of the MOD, the Defence Research Agency (DRA). The DRA became a trading fund in 1993, and following significant improvements in operating performance, acquired 11 other agencies and operating units from the MOD in 1995, including the A&AEE (Aeroplane & Armament Experimental Establishment) at Boscombe Down, to form the Defence Evaluation and Research Agency (DERA).

Following a restructuring in 2001, certain functions of DERA, encompassing the majority of the organisation's capabilities for defence and security and amounting to approximately three quarters of DERA, were formed into QinetiQ Limited, an entity which is a wholly-owned subsidiary of QinetiQ Group plc. In February 2006 QinetiQ was listed on the London Stock Exchange with a market capitalisation of £1.3 billion. QinetiQ has since made acquisitions in the US, but its UK operation is split into two sectors; Defence and Technology (which encompasses Air, Sea, Land, Weapons, Command and Intelligent Systems and Communications technologies) and Security and Dual Use (Materials, Energy, Space and Security technologies).

The major aeronautical test facilities lie within the Aerodynamics and Aeromechanical Systems Group of the Air technologies Division. This Group employs 130 scientists and engineers employed in the full range of aeronautical activity, from fundamental research to acceptance and modifications of service aircraft, and consultancy activities for non-aeronautical applications. Its two major facilities are the 5m Pressurised Low Speed Wind Tunnel and the Noise Test Facility, both located at QinetiQ's Farnborough site.

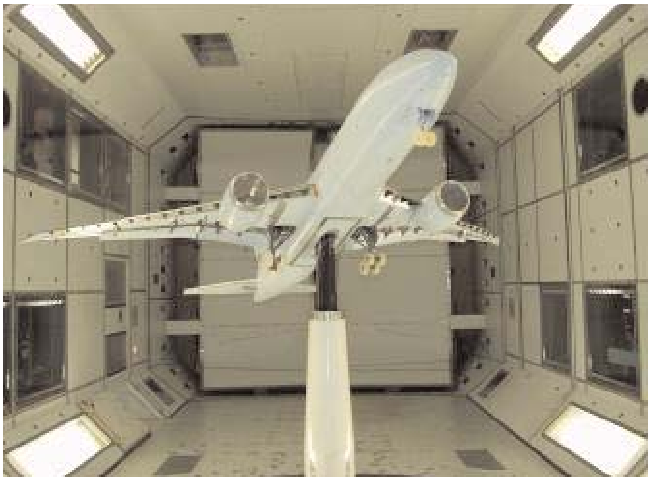
The 5 Metre, Pressurised, Low-speed Wind Tunnel was constructed during the 1970's to provide a low-speed wind tunnel where the effects of compressibility and scale can be investigated separately, to facilitate the design of aircraft with improved low-speed performance; reduce the level of developmental flying; and reduce the risk of expensive modifications being required at the flight test stage. It is fully self supporting commercially, having transitioned from supporting research programmes to almost full time 'production' testing for commercial customers.

The facility is a closed circuit, pressurised tunnel, which can be operated at total pressures ranging from atmospheric pressure (~101.3 kPa, 14.7 psi) up to 300 kPa (43.5 psi). The maximum speed in the test section ranges from M = 0.32 at atmospheric pressure, to M = 0.27 when the tunnel is operated at a total pressure of 300 kPa.

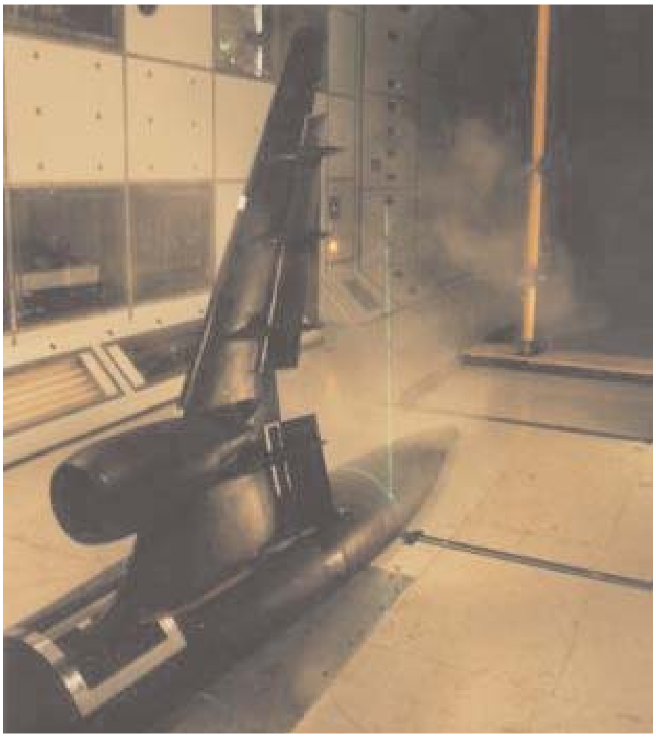
The tunnel was designed for high productivity during testing. The test section can be isolated and evacuated to atmospheric pressure, whilst the rest of the tunnel circuit remains pressurised. This greatly reduces the time required to access the model for changes to the model configuration.

In addition, the model is mounted on one of four interchangeable carts, which forms the floor of the working section. When a cart is not in use in the test section, it is parked in one of the rigging bays adjacent to the tunnel. Thus it is possible for a model to be rigged, whilst another model is tested in the tunnel.

The use of the interchangeable cart system offers a wide range of model support options, including strut mounting or sting mounting of whole-models, and floor mounting of half-models.



Model in the test section of the QinetiQ 5m Wind Tunnel



PIV measurements in the 5m Wind Tunnel at 3 atmospheres pressure

The wind tunnel test section walls are fitted with many surface pressure tappings that facilitate the use of the two-variable wall pressure signature method for the correction of highly-separated flows which are commonly experienced during high-lift testing.

Spotlight on QinetiQ

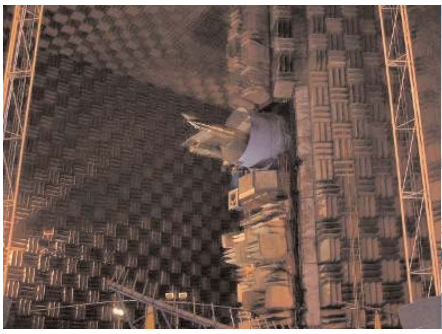
The Noise Test Facility (NTF)

The QinetiQ Noise Test Facility (NTF) is a very large anechoic chamber designed for aero-acoustic measurements. The chamber is one of the largest in the world, having internal dimensions of 27m (88 ft) long by 26m (85 ft) wide by 14m (46 ft) high. Its size enables true far-field noise measurements to be made at a representative model scale. Although designed for aero-engine studies, the chamber's capabilities provide an environment for a wide range of acoustic and other work to be undertaken including such problems as infra-red jet imaging.

Enhancements to the NTF have provided dedicated air supplies for both the model and flight stream. This enables the testing of large models (up to 10% scale of large turbo fans) in a 1.8m diameter flight simulation flow. The model size is now comparable to those used for performance testing. The larger flight stream can be used for other aero-acoustic studies.

The NTF has traditionally been used to study take-off noise employing 1/10-scale engine models and a Mach 0.3 flight simulation stream in which the engine model sits. However, cabin noise at cruise is becoming an issue with engine exhaust noise being a particular concern. While at take-off the jet exhaust flows of turbofans are subsonic, during cruise they are supersonic and generate shock associated noise. To simulate this it was necessary to extend the envelope of the NTF to achieve ~ Mach 0.8 cruise speed flight stream. The solution was to build an open circuit wind tunnel with a diffuser (essentially a large convergent-divergent nozzle) that attaches to the existing NTF flight stream duct. This has provided a facility for testing 1/25th scale exhaust models at realistic exhaust conditions and provides a practical means of studying performance of noise reduction measures at cruise. It has since shown that co-axial shock noise has many of the features of single stream jets and source location studies have shown that the primary source region of shock noise production is further downstream at approximately 7 nozzle diameters.

For more information on QinetiQ please visit their website at www.qinetiq.com



1/10-scale model in the NTF

Serrated nozzle developments on the engine and in the NTF - *Pictures courtesy of Boeing and Rolls-Royce*

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European Transonic Windtunnel GmbH	DE
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