

## Aircraft Noise and Aeroacoustics Research in the UK



Workshop held on 2<sup>nd</sup> April 2014 at the Centre for Aviation, Transport and the Environment, Manchester Metropolitan University.

Workshop sponsored by X-Noise EV and AeroTraNet 2.

The United Kingdom X-Noise Network in Aeroacoustics was established in 2006, and is one of a number of national and regional networks which have been formed under the auspices of X-Noise. The key aim of these networks is to improve the integration of European research activities in aircraft noise. In the UK, the Institute of Sound and Vibration Research (ISVR), University of Southampton is the X-Noise United Kingdom National Focal Point (UK-NFP), and is responsible for coordinating the UK X-Noise Network in Aeroacoustics. Further information about this network is available at the webpage: [www.southampton.ac.uk/xnoiseuk/](http://www.southampton.ac.uk/xnoiseuk/).

One of the key activities undertaken with support from X-Noise is the organisation of local national and regional networking meetings to bring together people from national organisations that are not directly partners of the X-Noise consortium. In the UK, the aims of some of these previous meetings have included discussion of strategic research priorities, promotion of new collaborations, reviewing opportunities for research funding, and dissemination of information on research activities in aircraft noise. In 2014, a new format of the meeting was trialled. Instead of focusing on strategy and funding for new research, this year a one-day postgraduate workshop was organised to promote research being undertaken in the UK, primarily by early career researchers. This informed the UK-NFP partners of the current and upcoming research ideas in aerodynamic noise to drive the noise modelling strategy.

The workshop was hosted by the Centre for Aviation, Transport and the Environment at Manchester Metropolitan University. Their assistance with the organisation of the workshop and with providing the venue is gratefully acknowledged. The workshop has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement no. 265943 and no. 317142.

The workshop was jointly supported by X-Noise EV and the Marie-Curie Initial Training Network AeroTraNet 2 on *Shock Associated Jet Noise*. More information about this network is available at the webpage: [www2.le.ac.uk/projects/aerotranet](http://www2.le.ac.uk/projects/aerotranet). AeroTraNet 2 is coordinated by the University of Leicester and was launched in 2012. In total nine Marie Curie Fellows have been appointed to work on different aspects of shock associated jet noise and all the fellows attended the workshop.

This brief report provides a summary of the workshop. In addition the workshop agenda is provided for information.

Following brief welcome presentations by Professor Paul Hooper (MMU), Dr Alan McAlpine (X-Noise EV UK-NFP), and Dr Aldo Rona (AeroTraNet 2), the workshop started with an invited talk by Dr Nick Humphreys from Rolls-Royce plc. Dr Humphreys gave a presentation on the "Industrial Needs for Aircraft Noise Research and Future priorities". This included an outline of the noise technology goals associated with Flightpath 2050, the relevance and inter-dependency of aircraft noise factors, a brief review of some recent achievements including some of the technological developments from the OPENAIR project, and, finally, a brief look at potential noise reduction approaches for future aircraft designs.

The workshop was split into three sessions. Each session had a different theme and included a variety of presentations that were mainly given by postgraduate research students. The first session was chaired by Dr Alan McAlpine (UK-NFP, University of Southampton) and was on "Airframe and open rotor noise". The presentations on open rotors included new theoretical and computational work. This included the prediction of time-harmonic rotating sources located in a reverberant space, for application to the appraisal of measurements of an open rotor obtained in a closed wind-tunnel; computational analysis to aid the design of open rotor blades, with a view to reducing tonal noise for non-zero angles of attack; and, long-range sound propagation in the atmosphere to assess en-route noise from open rotors. The presentations on airframe noise focussed on trailing edge noise, specifically the application of morphing structures or trailing edge serrations for noise control. (At this stage the former is being viewed for possible application to wind-turbine blades.) Accurate aeroacoustic measurements, in external or internal environments, are crucial to improve our understanding of aircraft noise. The remaining presentation in this session outlined new developments being undertaken in microphone technology, specifically for flush mounted microphones used in wind-tunnels, where it is necessary to be able to differentiate between unsteady hydrodynamic pressure fluctuations in turbulent flow and sound.

The second session was chaired by Dr Aldo Rona (AeroTraNet 2, University of Leicester) and was on "Jet Noise". This session included short presentations from the AeroTraNet 2 fellows. Most of the work that was reported was in the initial development stage, as the fellows had been in post for just over six months. The work being undertaken by the fellows was shown to be inter-linked, and all connected to the theme of shock associated jet noise. Of key interest is shock-cell noise associated with tones (screech) and broadband noise. Work being undertaken includes the design and build of new jet test rigs, advanced computational fluid dynamic simulations, development of post-processing data analysis techniques, error quantification and appraisal, and optimisation of the methodology to lead to practical methods for use by industry. The remaining presentation in this session, which was not part of AeroTraNet 2, was on installed jet noise. The specific problem being considered was jet-flap interaction noise, an issue which may become more prevalent as the diameter of new turbofan engines is increased.

The third and final session was chaired by Professor Colin Waters (Manchester Metropolitan University) and was on "Turbofan noise and aircraft noise effects on the community". Two presentations looked at the prediction and mitigation of community noise. One way to mitigate the community noise is via a Continuous Descent Approach (CDA). Studies in the UK and Romania have shown that the use of CDA can provide noise and fuel burn benefits, but the use of this operating procedure is not, at present, that common across Europe. A holistic approach to the prediction of aircraft noise illustrated the overall complexity of the problem, but that this type of prediction is viable and can provide practical results for the assessment of community noise. The session concluded with three presentations on modelling some different sources of noise from turbofan engines. Of interest was modelling

fan broadband noise, extending more traditional methods of gust-blade interaction, which use flat plate models, to more realistic aerofoil geometries. At take-off, the fan blades' tip speed is supersonic which generates another tonal noise source known as buzz-saw noise. This source can be modelled using nonlinear acoustics. A new combined time-frequency domain numerical algorithm was presented. Also the inter-stage region, between the fan and outlet guide vanes, contains strong swirling flow. A new duct acoustics project is seeking to assess the performance of acoustic liners for application in this region in a turbofan engine.

This concluded the workshop. In total forty-six people attended the event from eighteen organisations. A wide range of research topics were presented during the workshop. This highlighted the breadth and the importance of research on aircraft noise and aeroacoustics in the United Kingdom. The aerospace industry in the UK is one of the largest in the world supporting 230,000 jobs and contributing £24 billion to the economy every year (source: [www.gov.uk/government/news/uk-aerospace-industry-receives-2-billion-investment](http://www.gov.uk/government/news/uk-aerospace-industry-receives-2-billion-investment)). In March 2013 the UK Government announced £2 billion new funding for aerospace. The funding will support the new UK Aerospace Technology Institute (ATI) for research into the "next generation of quieter and more energy efficient aircraft". As part of the ATI, the UK Aerodynamics Centre has been formed. This is a new *virtual centre* in Cranfield University to oversee the UK strategy for aerospace research. The workshop was advertised on the new UK Aerodynamics centre's website ([www.ukaerodynamics.co.uk](http://www.ukaerodynamics.co.uk)). Building links between the United Kingdom X-Noise Network in Aeroacoustics and the UK Aerodynamics Centre is a goal which should help to promote future research as well as to support and to promote future workshops on aviation noise.

Alan McAlpine (UK-NFP, ISVR)  
7th April 2014