CASE STUDY

Warwick University
Warwick, England
Appraise Project

Europe
Automotive
NVH Vehicle Simulator

Brüel & Kjær is embarking on a major new research project with WMG, the global innovation specialists at the University of Warwick.

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Fig. 1 *The Full Vehicle NVH Simulator is a project based solution, where the desktop NVH simulator is integrated with a donor vehicle to add enhanced context to the evaluation of the NVH data.*

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Brüel & Kjær and Warwick Expand their Collaboration

WMG

WMG was established by Professor Lord Kumar Bhattacharyya in 1980 in order to reinvigorate UK manufacturing through the application of cutting edge research and effective knowledge transfer. The group started small – just an office, the Professor and his secretary – but has since grown into a global force, delving outside its manufacturing core into new sectors such as health, banking, the built environment and digital technology.

WMG now employs over 200 full time staff with a further 150 associates dedicated to delivering innovative research projects and sharing knowledge with a wide range of businesses and individuals through collaboration, knowledge transfer schemes, postgraduate study and bespoke training.

Brüel & Kjær

APPRAISE

Fig. 2
Dr. Paul Jennings

WMG's experiential engineering team, led by Dr. Paul Jennings, have already been collaborating with Brüel & Kjær on their interactive NVH Vehicle Simulator, along with another partner, Sound Evaluations Limited, who will also be involved in the new research. They will bring a multi-disciplinary approach, involving physics, engineering, design and psychology to the challenges of the new project. The project is called APPRAISE (Appropriate Product Representations for Assessment In Structured Evaluations) and is supported by the UK's Engineering and Physical Sciences Research Council through Warwick's Innovative Manufacturing Research Centre. APPRAISE will focus on the subjective evaluation of products and environments, with particular emphasis on automotive applications.

Warwick has been active in automotive sound quality research for a number of years. Recently, it has created novel prediction techniques for sound evaluations, improved generic analysis and data presentation methods and methodologies for the new interactive NVH Vehicle Simulator. Dr. Jennings states that, "Crucially, our research has highlighted the importance of appropriate product representation, context and interactivity within structured evaluations. Sound evaluations can be carried out using recordings or synthesised sounds alone, in test vehicles or using vehicle simulators. We need to understand how perceptions might be affected and might vary between them and most importantly how to ensure that any design decisions resulting from the analysis are valid". This new research project will focus on the relationship between real world assessment and structured evaluations in simulated environments. Its aim is to improve the effectiveness and efficiency of decision-making during product development based upon the results of subjective evaluations.

Specifically, the project will move on from capturing the opinions of people (in the form of scores or votes) to the development of consistent methods for capturing the actual "perception-forming" processes in different environments, for example, in real vehicles on-road or in different types of controlled laboratory test such as in a full-vehicle simulator or in a listening room. In fact, increasing the level of understanding about how subjective assessments are carried out (by customers and experts) on-road in real vehicles, will be valuable in its own right, improving consistency in current attribute assessment processes as well as validating approaches developed for other levels of reality.

A comparison of perception-forming processes across different levels of reality will be carried out. This will require the further development of both models and also the novel analysis and data capture techniques proposed in previous research. The project will also explore the use of different auralisation methods (for example, headphone playback, wave field synthesis or ambisonics) for presenting sounds to assessors. This aspect of the research will take advantage of a new facility for sound assessment to be built in Warwick's new building, their Digital Laboratory, as part of the project.

Dr. Jennings adds, "The project's primary focus is on the creation of new methods and knowledge. However in achieving this, we will generate data and models relevant for a new issue, the aspects of sound and vibration that are of specific importance to hybrid vehicles. Interactive environments, such as those provided by the NVH Simulator, are ideal for this. They provide a framework for capturing directly and robustly customer perception of the new NVH phenomena. They will allow the capture of customer opinion of both new sound sources and their opinion of new interactions, for example, as a result of the reduced masking from the internal combustion engine. This is in addition to providing a tool for engineers to carry out "what if" experiments where they can make changes in the engineering design of the vehicle, and then directly experience the difference in sound and vibration of the results".

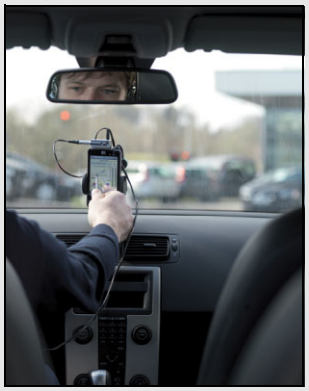
Vision

So, the outcome of this research will not only be an increased knowledge of customers' reactions to automotive sounds, in particular those from a future generation of hybrid vehicles, but

more importantly, a greater understanding of the optimum methodologies for future automotive design, based around real customer opinion.

SoNoScout – A Complementary Product for Easy Sound Recording

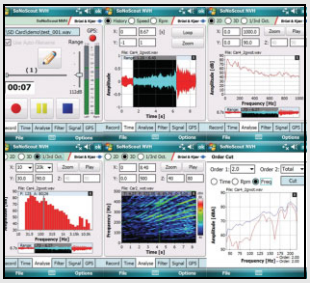
SoNoScout NVH – a Focused Automotive NVH Tool for Two-channel Sound Data Acquisition and Analysis



Imagine that you have managed to obtain one of those rare prototype vehicles or even a brand new competitive vehicle from a showroom. You have 30 minutes to record the vehicle's audio and performance data. You cannot start to take the vehicle apart to install tachometers. So what to do? Try using SoNoScout NVH, an ultra-portable, cost effective, easy to use recording and analysis system.

The system is ideal for use in any situation where it is impractical or impossible to attach a transducer or tachometer to a vehicle. The entire SoNoScout NVH system is contained in one rugged transport case, and the main components are compact enough to be carried in a coat pocket. SoNoScout's high portability enables you to obtain data anywhere . from road testing a competitor's vehicle to field testing in order to quantify customer complaints. SoNoScout is PDA based, and operated by a touch screen. The system can simultaneously record audio and vehicle performance data, which can be processed into NVH Vehicle Simulator models, and GPS data from which visual scenarios can be automatically generated. The RPM Finder generates engine speed vs. time from the Order Map whilst the vehicle speed vs. time information is generated from the GPS signal.

To maximise flexibility, the system comes with both an analogue sound card, which is connected to the included headset (headphones and microphones), and a digital sound card, which enables connection to existing digital binaural measuring devices. The recorded data is stored on an SD memory card. An analysis-only version of the software, which runs on a PC, is also included to allow more convenient data analysis.



Two version are available. SoNoScout Type 3653-B and the more extensive SoNoScout NVH Type 3653-A which includes a GPS unit and order analysis capability.

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