Novel use of MEMS microphones to map noise pollution

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The UK's National Physical Laboratory (NPL) has developed a new measurement-based approach to environmental noise monitoring and mapping using unique sensors. NPL in conjunction with Castle Group, QinetiQ and Hoare Lea Acoustics, and with support from the Technology Strategy Board have developed DREAMSys (a Distributed Remote Environmental Array & Monitoring System).

This new system uses a wireless array of low-cost MEMS (Micro Electro Mechanical Systems) microphones to provide a means of collecting noise data over a widespread area, for the purpose of augmenting the production and validation of noise maps.

MEMS microphones are already used widely in mobile phone and computing applications, but have yet to be exploited for precision noise measurements. This is partly because commercially available devices were not designed for such purposes and hence their performance characteristics were largely unknown in relation to measurement applications. So a key question before attempting to use MEMS microphones for measurement was how their performance compared with conventional instrumentation grade condenser microphones.

The DREAMSys project has addressed this and has successfully deployed MEMS microphones as part of a novel noise monitoring system, demonstrating for the first time their suitability for quantitative measurement and the benefits (in terms of size and cost) that they offer. The system is designed for prolonged outdoor use, so is resistant to

adverse weather conditions, and powered by rechargeable battery packs in order to run unattended continuously.

EU Directive (2002/49/EC) mandates that noise maps be produced for all roads, railways and civil airports, to inform strategic planning for noise control. However, measurement based approaches using conventional sound level meters, are not practical, mainly for economic reasons. The Directive therefore requires maps to be produced from noise predictions, with all their inherent assumptions and limitations. Consequently, some European authorities have reported difficulty in using these noise maps due to a lack of confidence in the output data and complete absence of temporal variation. These issues can be resolved by including a role for measurement in the process, but it is currently too expensive to use the instruments available to achieve the spatial coverage required.

DREAMSys aims to address this by providing a cost-effective solution to the distributed measurement of noise over a widespread area. Components of the system have been thoroughly tested and calibrated by NPL, and results of testing both in the laboratory and outdoors indicate a high degree of consistency with conventional equipment.

Following initial tests the system has been deployed in a small number of UK field trials lasting a few days to in excess of 10 months. These field trials have now been completed successful. The flagship test site was an area of land adjacent to a major airport, earmarked for residential development where 40 units were deployed for a period of 10 months. Trials have also been carried out in a busy city centre and elsewhere. The data collected was used for mapping the sound fields using bespoke software developed at NPL. These trials explored the role of measurement in the strategic noise mapping process and showed how a low-cost measurement array can enhance the traditional predictive approach.

Richard Barham, Principal Research Scientist in NPL's Acoustic Group said:

"DREAMSys greatly expands the coverage offered by the measurement system in conventional equipment. It enables a large number of measurement points to be installed and used to continually monitor an area for months or even years. However, it is not intended that DREAMSys replaces prediction entirely. We hope that both approaches will complement each other, with the measurements being made in areas carefully selected on the basis that action plans would be significantly enhanced as a result. This shows the essential role that cutting edge measurement science can have in helping to meet specific challenges."

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