EMRP Call 2011 - Health, SI Broader Scope & New Technologies

Selected Research Topic number: **SRT-h11**
Version: 1.0

Title: Metrology for a universal ear simulator and the perception of non-audible sound

Abstract:

This topic aims to improve the traceable measurement of human response to sound. It will focus on two areas:

- Methods applied to young and newborn children - as early diagnosis of neonatal hearing disorders is a crucial prerequisite for language acquisition and education, and
- Frequencies outside the normal audible range which can be perceived by humans and could potentially be harmful or annoying

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP Outline 2008, section on “Grand Challenges” related to Health on pages 7, 8 and 9 and in the section on “Specific developments in acoustics, ultrasound and vibration” on page 37.

Keywords

Magnetoencephalography, brain imaging, hearing damage, hearing conservation, hearing threshold, infrasound, airborne ultrasound, risk assessment, audiology, ear simulator.

Background to the Metrological Challenges

Existing methods of determining human response to sound rely on the subject indicating whether they detect that sound or not. These methods have been well established with adults for many decades and are the basis of regulation across Europe. Different methods are required when the subject is unable to respond as in the case of young and newborn children, or the sound is at extreme frequencies where the subject may not perceive it as normal sound. This SRT aims to improve measurement in these areas.

Early diagnosis of neonatal hearing disorders is a crucial prerequisite for language acquisition and education. Objective methods that utilise spontaneous physiological indicators of hearing function, e.g. the measurement of Auditory Evoked Potentials (AEP) and Otoacoustic Emissions (OAE) have been adopted into routine practice ahead of the necessary calibration techniques – a new ear simulator is required to provide robust calibration techniques for these new methods.

Many sound sources arising from new technologies such as wind turbines, heat pumps, or sonochemical reactors emit sound in the infra- or ultrasound ranges. This non-audible noise can be perceived by humans and could potentially be harmful or annoying, so a risk assessment is required under EU directives. The perception mechanism of this non-audible noise is not clear to date. It could be investigated using modern imaging techniques like magnetoencephalography and magnetic resonance tomography to develop methodology and strategies for a risk assessment based on measured hearing and sensing thresholds and new sound measurement strategies.

There is currently very limited regulation of this area, with recommendations being based on limited and controversial data.

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EMRP
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Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP-Protocol.

The JRP shall focus on the traceable measurement and characterisation of ear simulators and systems for measuring human brain response to acoustical stimuli.

The specific objectives are:

1. The design, test, and validation of a universal ear simulator for calibrating all sorts of headphones used in clinical audiological tests at least in the frequency range from 125 Hz to 16 kHz, and for hearing screening on adults, young and newborn children. Validated calibration procedures and reference data should be provided in a form suitable for subsequent international standardisation.
2. Determination, by magnetoencephalography and magnetic resonance tomography, of the brain areas where infrasound and air-borne ultrasound generate brain responses. Determination of the minimum sound pressure levels where the onset of brain activation occurs should be done with an accuracy better than 5 dB. These minimum activation levels should be related to established pure tone hearing thresholds, and consequential recommendations made for maximum acceptance values for infra- and ultrasound.

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes, and it is expected that multidisciplinary teams will be required. To enhance the impact of the research, the involvement of the appropriate user community such as medical practitioners and industry is strongly recommended.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

The total eligible cost of any proposal received for this SRT is expected to be around the 2.7 M€ guideline for proposals in this call.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (e.g. letters of support) is encouraged.

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

You should detail how your JRP results are going to:

- Feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge to audiology practitioners

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.