Measurement scientists set a new standard in 3-D ears

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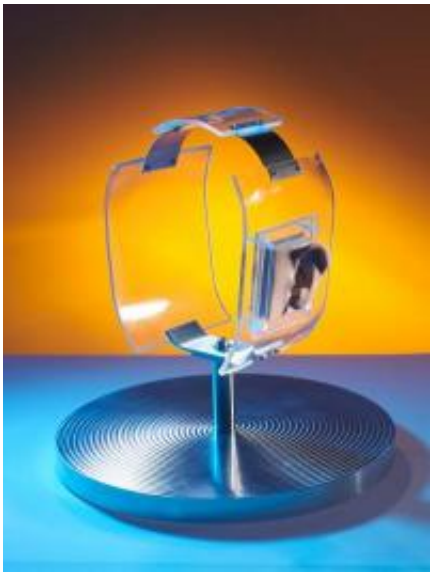

This is an image of the NPL artificial ear. Credit: NPL

Scientists at the UK's National Physical Laboratory (NPL) have developed a means of representing a 3D model ear, to help redefine the standard for a pinna simulator (the pinna is the outer part of the ear) – used to measure sound in the way we perceive it.

The nature of human hearing is heavily dependent on the shape of the head and torso, and their interaction with sound reaching the ears allows for the perception of location within a 3D sound field.

Head and Torso Simulators (HATS) are designed to model this behaviour, enabling measurements and recordings to be made taking account of the Head Related Transfer Function (HRTF) - the difference between a sound in free air and the sound as it arrives at the eardrum.

HATS are mannequins with built-in calibrated ear simulators (and sometimes mouth simulators), that provide realistic reproduction of the acoustic properties of an average adult human head and torso. They are ideal for performing in-situ electro-acoustic tests on, telephone handsets (including mobile and cordless), headsets, audio conference devices, microphones, headphones, hearing aids and hearing protectors.

This image shows ear scanning. Credit: NPL

Critically the shape of the pinna has a large effect on the behaviour, and as a result it is defined for HATS by its own standard (IEC TR 60959:1990) to provide consistency across measurements. However, this standard defines the shape of the pinna through a series of 2D cross-sectional profiles. This form of specification and definition has on occasion proven to be an inadequate guide for manufacturing processes.

As part of a revision of this standard, the Acoustics Team at NPL teamed up with the National Freeform Centre in a novel move to redefine the standard through an on-line 3D CAD specification. A model ear was measured using a coordinate-measuring machine with laser scanner to produce a 3D scan of the ear, which can then be used to provide manufacturers with a more practical specification for reproduction and a standard that is easily comparable with similar non-contact freeform measurement techniques.

Ian Butterworth from NPL, said:

"Having a 2D pinna in an artificial ear has some inherent frequency limitations. For example, when sound spreads through structures like narrow tubes, annular slits or over sharp corners, noticeable thermal and viscous effects take place causing further departure from the lumped parameter model. The new standard for the 3D model has been developed to give proper consideration to these effects. We worked with the National Freeform Centre, experts in measuring items that are unconventional in shape or design, to develop the new standard – which will now help manufacturers develop better products."

Provided by National Physical Laboratory