Absorption and Scattering of Sound by Structures: New Ideas for Old Problems

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Noise is an annoyance central to modern life especially in densely populated areas, and methods to reduce how we hear unwanted sounds are more important than ever. Sound absorbing walls are usually thick and heavy, e.g. highway barriers. This type of absorption depends on the wall mass but not on any internal mechanism that can eat up acoustic energy. Foams and walls treatments which are light, combine porosity and viscous damping to attenuate the sound, but still require large thickness. The ideal is to have thin absorbers that are effective over a broad range of frequencies. However, in order to work at low frequencies the size has to scale up with the wavelength because the wavelengths are large. The talk will present some recent revolutionary ways to absorb sound over wide ranges of frequency. The central theme is to use internal resonators which concentrate the energy in small volumes, allowing for much smaller structures. Different mechanisms for achieving this will be described, including membrane oscillators, and Helmholtz resonators. The concepts will be demonstrated with an adjustable sound tube in which the attenuation mechanisms can be tuned to reduce the transmitted sound.

As an undergraduate in Dublin, Ireland, **Andrew Norris** aimed for a future in mathematical physics but changed course after moving to the USA where he did his PhD in Engineering Sciences and Applied Mathematics at Northwestern University. After a few years working with Exxon he moved to Rutgers University where he is a professor of Mechanical Engineering. The common theme all along has been an intense interest in acoustic and elastic waves, which share the same characteristic qualities. He found that learning about seismic waves provides better understanding of acoustic phenomena, and vice versa. His current research is in acoustic and elastic metamaterials, focused on underwater applications. Acoustic metamaterials use concepts that at first sight might appear to be pushing the limits of physics, but are still feasible. A prominent example is transformation acoustics, which can lead to exotic effects such as cloaking, but is also the basis for designing accurate acoustic lenses. Dr. Norris has recently used these ideas to design and demonstrate underwater acoustic focusing devices, with help from collaborators. Dr. Norris is a Fellow of ASA, an Associate Editor of JASA, and in 2016 delivered the Tutorial Lecture at the ASA meeting in Salt Lake City.