ACOUSTICS2008/3064
Thermoacoustics in random fibrous materials

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Current approaches to acoustics in fibrous and porous materials use fitting parameters to match theoretical models to measured values for the material's complex compressibility and wavenumber. In effect, these models treat the material as though it were composed of an array of rigid capillary tubes; they have proven accurate in fitting the model to data for various different porous materials such as wools and foams. However, these models do not address thermoacoustic heat transfer when the material is put under a static temperature gradient. A direct simulation has been performed using a three-dimensional thermal fluid solver to calculate both the acoustic properties and the thermoacoustic properties of a random fibrous material. The results of the simulation will be compared to experimental results for complex compressibility and wavenumber [Tarnow, H., J. Acoust. Soc. Am., 97(4),2272-81] as well as a proposed extension to porous theory that incorporates thermoacoustics [Roh et al., J. Acoust. Soc. Am., 121(3), 1413-22]. [Work supported by U.S. Army Space & Missile Defense Command.]