Topology optimized cloak for airborne sound

Directional acoustic cloaks that conceal an aluminum cylinder for airborne sound waves are presented in this paper. Subwavelength cylindrical aluminum inclusions in air constitute the cloak design to aid practical realizations. The positions and radii of the subwavelength cylinders are determined by minimizing scattering from the cloak-structure and cylinder using the gradient-based topology optimization method. In the final optimization step, the radii of the subwavelength cylinders are constrained to three discrete values. A near-perfect narrow-banded and angular cloaking effect is obtained by optimizing for one target frequency. To get a larger bandwidth, the acoustic cloak is optimized for three frequencies at the cost of reduced peak cloaking performance at the center frequency. Copyright © 2013 by ASME.