# Acoustic Cloaks for Airborne Sound

José Sánchez-Dehesa

Wave Phenomena Group, Universitat Politècnica de València, Valencia, Spain

Email: jsdehesa@upv.es

A review on the recent advances in the design and construction of acoustic cloaks will be presented. The starting point is the work of Cummer and Schurig[1], who in 2007 proposed and omnidirectional and broadband cloak in a two-dimensional (2D) space. The cloak was based on acoustic metamaterials with anisotropic and inhomogeneous mass density. Since this seminal work, many efforts have been devoted in designing artificial structures with dynamical mass anisotropy. For example, mass anisotropy has been demonstrated using corrugated cavities[2]. However, it has been shown that the requested conditions for airborne cloaks are impossible to achieve unless an additional physical mechanism is introduced allowing the increasing of the sound speed with respect to that of the air background. It has been proposed that temperature is one of such possible mechanisms, but the designed cloak requires the control of strong temperature gradients[3]. Therefore, in order to make acoustic cloaks feasible the conditions of broadband and omni-directionality have been removed in the design procedure. Acoustic cloaks in 2D and three-dimensions have been reported that conceal the scattering from a cylinder[4] and from a sphere[5], respectively, in a narrow frequency range and for a selected direction.

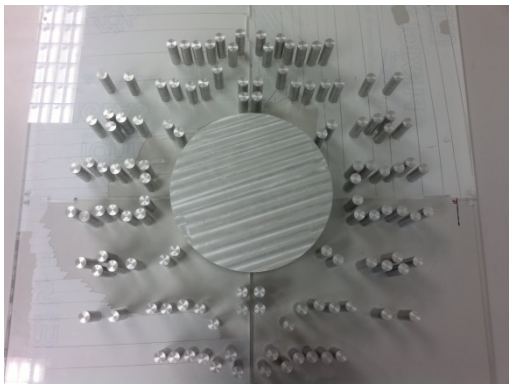

Fig. 1: Two-dimensional cloak allowing the acoustic concealing of a cylinder[4].

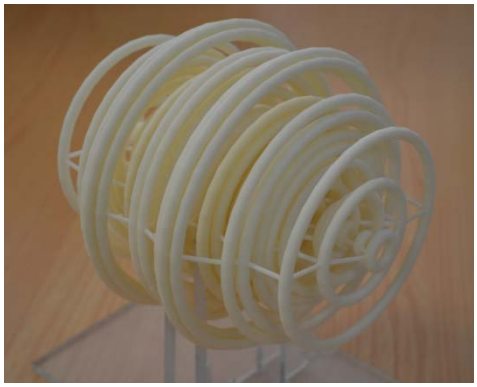

Fig. 2: Three-dimensional cloak allowing the acoustic concealing of a sphere[5].

[1] S. A. Cummer and D. Schurig, "One path to acoustic cloaking", New J. Phys., vol. 9, 45, 2007.

[2] D. Torrent and J. Sánchez-Dehesa, "Anisotropic mass density by radially periodic structures", Phys. Rev. Lett, vol. 105, 174301, 2010.

[3] V. M. García-Chocano, D. Torrent and J. Sánchez-Dehesa, "Reduced acoustic cloaks based on temperature gradients", vol. 101, 084103, 2012.

[4] V. M. García-Chocano et al., "Acoustic cloaks for airborne sound by inverse design", Appl. Phys. Lett., vol. 99, 074102, 2011.

[5] L. Sanchis et al., "Three-dimensional axisymmetric cloak based on the cancellation of acoustic scattering from a sphere", vol. 110, 124301, 2013.