Invisibility cloak for structured plates

Diego Misseroni[1], Alexander B. Movchan[2], Natasha V. Movchan[2], Ian S. Jones[3], Daniel J. Colquitt[2]

[1]*DICAM, University of Trento, Italy*
E-mail: diego.misseroni@unitn.it

[2]*Department of Mathematical Sciences, University of Liverpool*
E-mail: abm@liverpool.ac.uk; *E-mail*: nvm@liverpool.ac.uk;
E-mail: D.Colquitt@liverpool.ac.uk

[3]*Mechanical Engineering and Materials Research Centre, Liverpool John Moores University*
E-mail: I.S.Jones@ljmu.ac.uk

Keywords: Metamaterials, cloaking, scattering reduction.

The elastic invisibility cloak for flexural waves in a structured plate is validated through both numerical FE simulations and physical experiments.
Experimental set-up and numerical simulation consider three different lattices, namely a homogenous lattice, a lattice with a hole, and a lattice with a cloaked hole. The lattices, constrained by clamps on the two shorter sides and having the other sides free, have been excited by using a Shaker connected to the left clamp.
The considered mechanical and geometrical properties of the cloak are based on the regularised cloaking transformation and the theoretical design as reported Colquitt et al. for membrane waves [1] and later for flexural waves in plates [2].
The qualitative assessment of the efficiency of the cloak was provided experimentally by using the Hooke-Chladni-Faraday technique which shows the positions of the nodal lines of the vibrating plate.

Acknowledgements
The research leading to these results has received funding from the ERC Advanced Grant 'Instabilities and nonlocal multiscale modelling of materials' FP7-PEOPLE-IDEASERC-2013-AdG (2014-2019).

References
[1] *Colquitt, D. J. et al. "Making waves round a structured cloak: lattices, negative refraction and fringes". Proc. R. Soc. A. 469, 20130218 (2013).*
[2] *Colquitt, D. J. et al. "Transformation elastodynamics and cloaking for flexural waves". J. Mech. Phys.Solids. 72, 131–143 (2014).*