Cloaking of flexural vibrations in a structured plate

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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.
In addition, the quantitative data, characterising the effectiveness of the cloak, were presented as the set of Fourier coefficients C_k, measured for the scattered fields on a circle of a sufficiently large radius, around the uncloaked and cloaked holes (the size of both holes is 80 mm) and compared with the reference Fourier coefficients, corresponding to a plate with a small hole (of the size 20 mm).
Results for the case of oscillatory boundary displacement condition with a frequency of 120 Hz and reported in Fig.1 (numerical simulations, upper part, and experimental tests, lower part) confirm that the considered elastic lattice cloak displays high efficiency within a predicted frequency range.

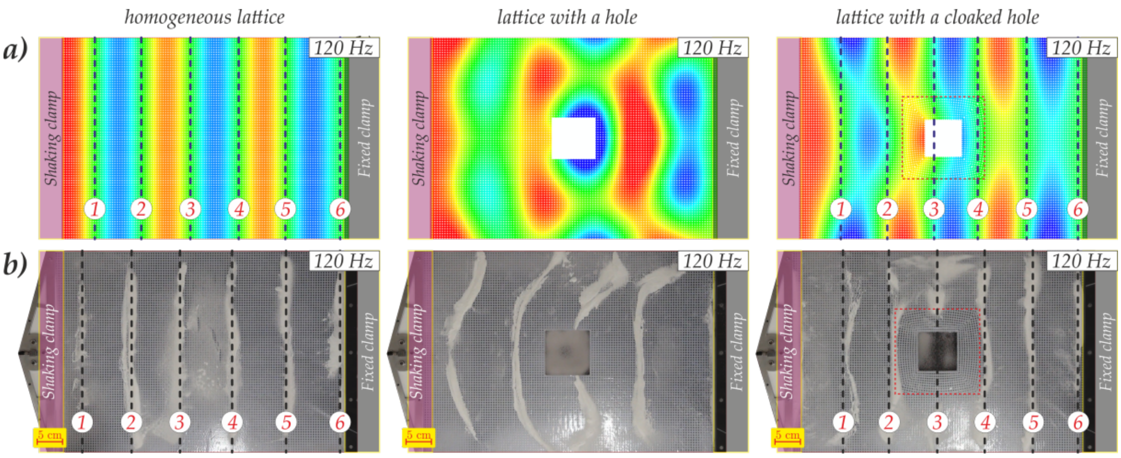

Figure 1: Comparison between the experiments and numerical simulations in the case of an applied displacement with a frequency of 120 Hz.

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References

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