A new approach for proving the absence of trapped modes in heterogeneous open media.

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Abstract

It is well known that acoustic trapped modes may occur in locally perturbed or bent closed waveguide. From the mathematical point of view, such modes correspond to eigenvalues of the Laplace operator, which are embedded in the essential spectrum. One can wonder if trapped modes also exist for open waveguides (like optical fibers for instance). The answer is generally negative.
I will present in particular a simple approach, combining Fourier representations and analyticity arguments, which proves the absence of nonzero L2 solutions to the two-dimensional Helmholtz equation in a conical domain, with a vertex angle greater than pi. This result (which can be extended to higher space dimensions) shows that for a medium filling the whole plane, there are no trapped modes if all the inhomogeneities (penetrable or not) are contained in a conical domain with a vertex angle less than pi. This is the case for instance of a bent open waveguide.

Our approach can be extended under some conditions to the junction of open waveguides, using a generalized Fourier transform instead of the usual one.
This work has been done in collaboration with Christophe Hazard, Sonia Fliss and Antoine Tonnoir.

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