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A few techniques to achieve invisibility in acoustic waveguides

The aim of this lecture is to consider a concrete problem, namely the identification of situations of invisibility in waveguides, to present techniques and tools that may be useful in various fields of applied mathematics. To be more specific, we will be interested in the propagation of acoustic waves in guides which are unbounded in one direction. In general, the diffraction of an incident field in such a structure in presence of an obstacle generates a reflection and a transmission characterized by some scattering coefficients. Our goal will be to play with the geometry, the frequency and/or the index material to control these scattering coefficients. We will explain how to:

- develop a continuation method based on the use of shape derivatives to construct invisible defects;
- exploit complex resonances located closed to the real axis to hid obstacles;
- construct a non self-adjoint operator whose eigenvalues coincide with frequencies such that there are incident fields whose energy is completely transmitted.

Our approaches will mainly rely on techniques of asymptotic analysis as well as spectral theory for self-adjoint and non self-adjoint operators. Most of the results will be illustrated by numerical experiments.

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