# Perfect absorption of flexural waves: complex frequency plane interpretation and experimental validation


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**Abstract**

In this work we discuss the possibilities and the limits of perfect absorption of flexural waves by open lossy resonators. By applying the analysis of the eigenvalues of the scattering matrix in the complex frequency plane we present the limits of absorption in the reflection and transmission problems for one- and two-dimensional problems. Analytical models based on transfer matrix method of multiple scattering theory are used to show obtain the scattering parameters. For the case of 1D systems, the hypotheses on which the analytical model relies, are validated by experimental results. The open lossy resonators considered in this work, present both energy leakage and inherent losses due to the viscoelastic damping. Wave absorption is found to be limited by the balance between the energy leakage and the inherent losses of the open lossy resonator. The perfect compensation of these two elements is known as the critical coupling condition and can be easily tuned by the geometry of the resonator. On the one hand, the scattering in the reflection problem is represented by the reflection coefficient. A single symmetry of the resonance is used to obtain the critical coupling condition. Therefore the perfect absorption can be obtained in this case. On the other hand, the transmission problem is represented by two eigenvalues of the scattering matrix, representing the symmetric and anti-symmetric parts of the full scattering problem. In the geometry analyzed in this work, only one kind of symmetry can be critically coupled, and therefore, the maximal absorption in the transmission problem is limited to 0.5. The results shown in this work pave the way to the design of resonators for efficient flexural wave absorption.


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