Métaréseaux pour la réflexion et la transmission anormales de fronts d'onde acoustique dans l'eau

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Abstract

A metagrating is a periodic assembly of scatterers designed to reflect or refract a wave toward an anomalous direction, not predicted by Snell's law. In this work, we designed, fabricated, and experimentally characterized such metagratings for the control of ultrasonic waves in water, using brass tubes and cylinders as well as 3D-printed plastic supports. These metagratings enable the redirection of an incident wavefront to an arbitrarily desired direction with high efficiency (close to 100%), both in reflection on a surface (e.g., the water/air interface) and in transmission. The theoretical approach is based on the principles of Bragg diffraction and constructive and destructive wave interactions. The results of this thesis demonstrate the efficiency of metagratings in inducing acoustic phenomena such as retroreflection and asymmetric wave response, achieved through the use of resonant and non-resonant structures, validated by finite element simulations and experiments. This research opens new perspectives for the manipulation of underwater acoustic waves, with potential applications in the fields of wave detection, absorption, and reflection in marine environments.