



Wave control with space-time manipulations

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Time-reversal processing is based on Huygens principles and on wavefield manipulation on spatial boundaries. It provided an elegant way to back propagate a wave field towards its initial source allowing to create, through any complex medium, a wave pattern of any required shape restricted only by diffraction limits.

Here we want to revisit these approaches by introducing another point of view, the one that Loschmidt proposed in his famous argument to create a time-reversal experiment by inverting instantaneously all velocities of the particles in a gas. The extension of this concept to wave will be discussed through the concept of time boundaries manipulation. Experiments, conducted with water waves, validating this approach will be presented. We show that sudden changes of the medium properties generate instant wave sources that emerge instantaneously from the entire space at the time disruption. The time-reversed waves originate from these “Cauchy sources” which are the counterpart of Huygens virtual sources on a time boundary. It allows us to revisit the holographic method and introduce a new approach for wave control in complex media.

In the second part of this talk, we will discuss another approach to manipulate a wave field in reverberating medium by introducing tunable metasurfaces as spatial boundaries and we will emphasize this concept for microwaves.