Slow Sound acoustic diode

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Electrical diodes appeared more than a century ago and since this date this unidirectional device has a huge application in many practical system. In this view, considerable efforts have been made to control other types of wave, including acoustic where numerous applications can be imagined ranging from biomedical ultrasound imaging to environmental noise reduction. Different configurations have been proposed to achieve directional propagation using nonlinearity, breaking the time invariance of the system by modulating some of its properties over time, or else biasing the system with a vectorial field. In this study, the flow is used as a vectorial field that break reciprocity. It is known for a long time that the flow convective effect leads to nonreciprocal sound propagation.
In particular, we demonstrate theoretically and experimentally that an acoustical diode can be made in an airflow duct by slowing down the acoustic wave. In the Slow Sound region, the effective sound velocity can be so low that no wave can propagate against the flow while the propagation is still possible in the flow direction. The sound is slowing down by putting locally reacting tubes in the wall of the duct. This phenomenon can occur on a large frequency range that can be extended to very low frequencies.