

## Study on Nonreciprocal Behavior in Time-Space Modulated Beams

Control of structural band-gaps via shunted piezoelectric patches

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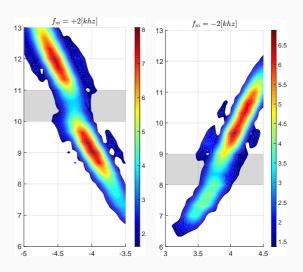


Figure 1: Rexport with label on axis

## References i



G. Cazzulani and G. Brambilla.

062239 - metamaterials and metastructures, 2024.

Lecture slides, Politecnico di Milano.



N. Hagood and A. von Flotow.

Damping of structural vibrations with piezoelectric materials and passive electrical networks.

Journal of Sound and Vibration, 146(2):243-268, 1991.



J. Marconi, E. Riva, M. Di Ronco, G. Cazzulani, F. Braghin, and M. Ruzzene. Experimental observation of nonreciprocal band gaps in a space-time-modulated beam using a shunted piezoelectric array.

Phys. Rev. Appl., 13:031001, Mar 2020.



E. Riva, J. Marconi, G. Cazzulani, and F. Braghin.

Generalized plane wave expansion method for non-reciprocal discretely modulated waveguides.

Journal of Sound and Vibration, 449:172–181, 2019.



G. Trainiti and M. Ruzzene.

Non-reciprocal elastic wave propagation in spatiotemporal periodic structures.

New Journal of Physics, 18(8):083047, Aug. 2016.



