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Breaking the symmetry of sound propagation FREE

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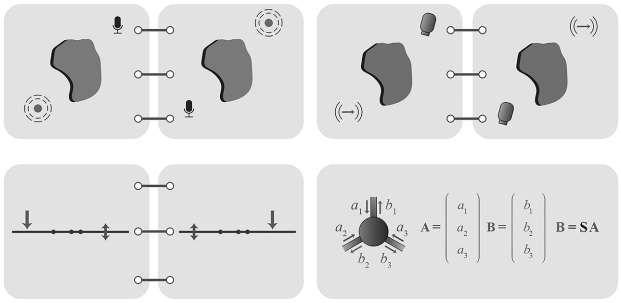
The physics of acoustic nonreciprocity – the notion hearing sound does not have to be equal on both sides.



When you talk to someone in a room, you probably expect -- all hearing-related abilities being equal -- you can hear them, and they can hear you if you both speak in the same volume. This concept, known as acoustic reciprocity, can usually explain how sound waves travel through common materials.

However, there are scenarios for which the sound volume going in is not equal to the sound going out. Rasmussen et al. explain the physics of this acoustic nonreciprocity and discuss where the field may be headed.

The authors aim to introduce acoustic nonreciprocity to unfamiliar audiences, showing where the field is today and what opportunities may be present for the future. The report provides a more detailed look on two up and coming topics of particularly interest: nonreciprocal topological acoustics and nonreciprocal surface acoustic wave devices.

Nonreciprocal topological acoustics describes the scenario of how sound can travel nonreciprocally between two points, even when the path between them is dramatically altered. Nonreciprocal surface acoustic wave devices can dramatically enhance how cellphones and other electronic devices operate.

“Only recently has the study of techniques to break this symmetry [of acoustic reciprocity] become a topic of extensive investigation,” co-author Andrea Alù said.

The authors highlight multiple opportunities for future work in acoustic nonreciprocity, which should continue to play a role in demonstrations of novel acoustic phenomena, such as improved sonar and wireless communications. Theoretical work has shown breaking reciprocity allows for a sonar array to transmit in one direction while receiving from an entirely different direction, but experimental demonstrations have yet to be realized.

Source: “Acoustic nonreciprocity,” by Curtis Rasmussen, Li Quan, and Andrea Alù, *Journal of Applied Physics* (2021). The article can be accessed at https://doi.org/10.1063/5.0050775.

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