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Surface resonant states in acoustic and elastic metamaterials[1]
MURALIDHAR AMBATI, DONGMIN WU, XIANG ZHANG, UNIVERSITY OF CALIFORNIA TEAM — We discuss a new type of surface acoustic wave at an interface between two media, one of which is a metamaterial. In contrast to the familiar case where the surface acoustic waves exist at solid-fluid and solid-solid interfaces, these unique waves exist because of the negative material responses in metamaterials. We explore the existence of a surface wave a) at the interface of a fluid and an acoustic metamaterial modeled as a fluid and b) at the interface of a solid and an elastic metamaterial modeled as a solid. The latter case is for shear waves with horizontal polarization (SH). In each of these two cases, first, we discuss the necessary and sufficient conditions on the material properties of metamaterials for the existence of surface modes. Second, we offer the microscopic picture of these surface modes in terms of particle trajectories at the interfaces. Next, we examine the unique characteristics of these surface states; as a result, we propose and numerically demonstrate an acoustic superlens for sub-diffraction limited imaging. Finally, we provide a design for metamaterials that can lead to the surface states and make a significant impact in ultrasonic imaging.

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