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The Generation and Propagation of Arterial Murmurs from a Stenosed Artery: A Computational Study[1] CHI ZHU, JUNG-HEE SEO, HANI BAKHSHAEE, RAJAT MITTAL, Johns Hopkins University — Cardiac auscultation - the procedure of diagnosing cardiovascular conditions using the stethoscope - has been used effectively for over a hundred years but still, the flow mechanism(s) responsible for the generation of these murmurs, as well as the effect of intervening tissue on the propagation of these murmurs, is not well understood. In this study, a one-way coupled, hybrid approach is used to investigate the propagation of murmurs generated from the flow in a stenosed artery. Specifically, the flow in the modeled artery is solved by an incompressible Navier-Stokes solver with the immersed-boundary method. The structural wave propagation in the tissue is resolved by a high-order, linear viscoelastic wave solver, and a mathematical decomposition is applied to separate the compressional and shear component of the acoustic wave propagating through the tissue. The simulations suggest, somewhat counterintuitively, that the shear wave contributes a significant component to the signal picked up by a stethoscope, and that this component carries much of the information that characterizes the source of the murmur. The implications of this for cardiac auscultation and further modeling of hemoacoustics are discussed. The effect of the stenosis severity and the flow pulsatility will also be investigated.

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