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An Inversion Strategy for Fully Characterizing Acoustic Elastic Scatterers.

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Abstract :
Recovering the characteristics of an unknown object such as a body or an inhomogeneity in a material from measurements of waves of fields scattered by this object is fundamental for exploring objects that are not accessible to in situ measurements. This class of problems is notoriously very difficult to investigate from both mathematical and computational aspects. In spite of their difficulties, inverse scattering problems have and continue to receive a great deal of attention by mathematicians, scientists, and engineers, as attested by the prolificness of papers and conferences dedicated to this topic. This is due, in part, to their relevance to a wide range of important applications such as seismology, radar and sonar, optics, along with many other areas in science and medical imaging technology. We discuss during the presentation various challenges for solving this class of inverse problems and provide a brief overview on the progress and accomplishments made in this area. We focus on the case of an elasto-acoustic scattering problem, as a prototype model problem, and present a novel solution methodology for determining all elastic scatterer parameters including the shape, the material properties (Lamé coefficients and density), and its location from the knowledge of far-field pattern (FFP) measurements. The proposed computational strategy is a multi-stage approach in which a carefully designed regularized iterative method plays a central role. The adopted approach is critical for recognizing that the different nature and scales of the sought-after parameters as well as the frequency regime have different effects on the scattering observability. Illustrative numerical results for two-dimensional elastic configurations highlight the performance of the designed inversion procedure.