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Joseph F. Keithley Award For Advances in Measurement Science: Resonant Ultrasound Spectroscopy: An Odyssey in Measurement Science[1]

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Perhaps the speeds of sound, or, equivalently, the elastic moduli are some of the most fundamental attributes of a solid, connecting to fundamental physics, metallurgy, non-destructive testing, and more. Unlike most of the quantities used to characterize condensed matter, the elastic moduli are fourth-rank tensors containing a wealth of detail, directional information, and consistency constraints that provide some of the most revealing probes of solids. We describe here the current state of the art in one method, Resonant Ultrasound Spectroscopy, where the mechanical resonances of a specimen of regular shape (easy to measure) are analyzed (difficult computational problem) to obtain the full elastic tensor. With modern advances in electronics and analysis, fractions of a part per million changes in elastic moduli are detectable providing new and important insight into grand challenges in condensed matter physics.

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