Extracting information from seismic data requires knowledge of seismic wave propagation and reflection. The commonly used method involves solving linearly for a reflectivity at every point within the Earth. The resulting reflectivity, however, is not an intrinsic Earth property, and cannot easily be extended to nonlinear processes which might provide a deeper understanding and a more accurate image of the subsurface.

In this book, the authors follow an alternative approach, which invokes inverse scattering theory. By developing the theory of seismic imaging from basic principles, they relate the different models of seismic propagation, reflection, and imaging – thus providing links to reflectivity-based imaging on the one hand, and to nonlinear seismic inversion on the other. Full, three-dimensional algorithms are incorporated for scalar, acoustic, and elastic wave equations.

The comprehensive and physically complete linear imaging foundation developed in this volume presents new results at the leading edge of seismic processing for target location and identification. The book serves as a fundamental guide to seismic imaging principles and algorithms, and their foundation in inverse scattering theory, for today's seismic processing practitioners and researchers. It is a valuable resource for geoscientists wishing to understand the basic principles of seismic imaging, for scientific programmers with an interest in imaging algorithms, and for theoretical physicists and applied mathematicians seeking a deeper understanding of the subject. It will also be of interest to researchers in other related disciplines such as remote sensing, non-destructive evaluation, and medical imaging.

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