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Preface

Special Issue on Seismic-Wave Propagation, Scattering, and Imaging
Dedicated to Professor Ru-Shan Wu's 80^{th} Birthday

Ru-Shan Wu is a special scientist who has made tremendous contributions in many fields of geophysics that he has worked on and has had strong impact on several generations of scientists throughout the world. He is appreciated for his contributions to science and for his generous, outgoing and happy personality that make him a role model for those who follow in his footsteps. Ru-Shan has sustained high-quality scientific output over the course of his long career. His work is widely recognized for its value and creativity. He has keen insight into the underlying physics of wave propagation and he continues to successfully transform that insight into fundamental advances in our understanding of wave propagation and imaging.

This volume is dedicated to Ru-Shan in celebration of his 80^{th} birthday in 2018. It follows a symposium, held at the University of California Santa Cruz, to honor Ru-Shan for his long and productive career. The workshop brought attendees from around the world, a testament to the broad influence of Ru-Shan's work. Many presentations covered work done in collaboration with or inspired by Ru-Shan. Those in attendance included students, professors, and researchers from industry and academia. Attendees ranged from new graduate students to retired professionals. Ru-Shan's impact will be felt long into the future. He has devoted himself not only to addressing important research problems but also to educating new generations of Earth Scientists.

Ru-Shan's career, still ongoing, has spanned more than 50 years. He was a member of the first group of distinguished Chinese Scholars who came to the United States in 1978 as part of the initiation of cultural exchange between China and the US after many years of mutual isolation. Even among a distinguished group, Ru-Shan stood out and remained in the US to pursue his research in seismology. His career blossomed from there. He earned his Ph.D. from MIT in 1984 working with Professor Keiiti Aki and remained as a Postdoctoral Associate. He then spent time in China, Brazil and Japan before settling at the University of California, Santa Cruz, where he has been as a *Researcher in Geophysics* since 1992. He has mentored many students pursuing advanced degrees, sponsored numerous postdocs, and hosted many visitors. He has made close collaborations with researchers worldwide. Those who encounter him are stimulated by the abundance of his ideas, insight, and energy, and are uplifted by his warmth and positive outlook on life.

We dedicate this volume to Ru-Shan on the occasion of his 80^{th} birthday. The volume contains research articles on seismic scattering, imaging, inversion, etc. We look forward to many more happy and productive years working with and learning from Ru-Shan.

This volume starts with an overview paper highlighting some of Ru-Shan's research in holography imaging, diffraction tomography, seismic-wave scattering and its applications to studying Earth's heterogeneity, one-way wave propagation and one-return wave modeling, beamlet and dreamlet and their applications, strong non-linear full-waveform inversion, and direct envelop inversion.

In Ru-Shan's paper on strong-scattering inversion, he uses the Schrödinger impedance equation for direct impedance inversion, and introduces a singular impedance function that corresponds to a singular potential for the reconstruction of an impedance profile, including discontinuities and long-wavelength velocity structures.

The volume contains two research articles on seismic scattering. Cormier et al. invert fluctuations in log-amplitude and traveltime of teleseismic P waves recorded by the EarthScope USArray for the heterogeneity spectrum of P-wave velocity in a 1000 km thick region of the upper mantle beneath the array. Feng et al. develop an equivalent source method to improve the phase accuracy of numerical modeling of forward seismic scattering wavefields in media with strong, large-scale velocity perturbations.

In the five research articles on seismic imaging, Wu et al. present a seismic imaging method using dreamlets, a combination of drumbeat and beamlet. Liu and Luo give a method to convert offset-domain common-image gathers to angle-domain common-image gathers using an invertible Radon transform. Li et al. present a stable Q-reverse-time migration method using an excitation amplitude imaging condition. Xie et al. study the impact of shallow heterogeneities on seismic imaging using resolution analysis. Li and Jia develop a staining method for one-way wave-equation-based seismic modeling and imaging.

The volume contains an additional eight research articles on seismic inversion. Wang and Wu extend the conventional contrast source inversion method to inversion of seismic reflection data. Geng et al. analyze the application of subspace methods to acoustic full-waveform inversion and the simultaneous updating of velocity and density. Huang et al. present an efficient target-oriented inversion method for time-lapse seismic data. Alkhalifah develops an efficient waveform inversion strategy that relies on a convex optimization problem for inverting for the wavefield and a modified source. Jakobsen et al. generalize the existing distorted Born iterative T-matrix method to seismic full-waveform inversion based on the scalar wave equation, for inversion in arbitrary anisotropic elastic media with variable mass densities and elastic stiffness tensors. Chi and Huang develop a source-independent full-waveform inversion method using a hybrid time- and frequency-domain scheme to avoid the requirement of source wavelet estimation and to reduce computational cost. Zheng and Liu use direct waveform inversion as a working strategy for performing waveform inversion. Finally, Wu and Wu examine factors affecting Q inversion.

In four research articles on seismic modeling, He et al. develop a weighted Runge-Kutta discontinuous Galerkin method for 3D acoustic and elastic wave-field modeling. Cho et al. present a generalized multiscale finite element method for modeling time-lapse 3D seismic wave propagation. Wang et al. use a 3-dimensional finite-difference method

to investigate the use of the abundant data collected by a monopole sonic tool, and study how to improve the tool design to acquire more useful data. Kai and Huang develop an elastic-wave sensitivity propagation method for optimal design of cost-effective time-lapse seismic surveys.

In addition, the volume includes three research articles on seismic signal analysis and one on rock properties. Bai et al. present a sparsity inversion method for eliminating interface-controlled seismic multiple signals. Zhou et al. develop a computationally efficient method for estimating primary seismic reflection signals. Wu and Wu give an improved filter based on equipoise pseudomulti-channel matching and the Huber norm for multiple suppression. Finally, Liu and Fu study elastic characteristics of shales using digital cores.

Special Issue Editors:

Lianjie Huang
Los Alamos National Laboratory
Geophysics Group, MS D452
Los Alamos, NM 87545, USA
ljh@lanl.gov

Michael Fehler
Massachusetts Institute of Technology
Dept. of Earth, Atmospheric, & Planetary Sciences
77 Massachusetts Avenue
Cambridge, MA 02139, USA
fehler@mit.edu