Session 1aUWa

Underwater Acoustics, Acoustical Oceanography, Signal Processing in Acoustics, Structural Acoustics and Vibration, Physical Acoustics and Biomedical Acoustics: Passive Sensing, Monitoring, and Imaging in Wave Physics I

Karim G. Sabra, Cochair
Mechanical Engineering, Georgia Institute of Technology, 771 Ferst Drive, NW, Atlanta, GA 30332-0405

Philippe Roux, Cochair
ISTerre, University of Grenoble, CNRS, 1381 rue de la Piscine, Grenoble 38041, France

Chair's Introduction—10:35

Invited Papers

10:40

1aUWa1. A single-sided representation for passive and active Green's function retrieval, time-reversal acoustics, and holographic imaging. Kees Wapenaar (Delft Univ. of Technol., Stevinweg 1, Delft 2628CN, Netherlands, c.p.a.wapenaar@tudelft.nl)

The homogeneous Green's function, defined as the superposition of the Green's function and its time-reversal, plays an important role in a variety of acoustic applications, such as passive and active acoustic Green's function retrieval, seismic interferometry, time-reversal acoustics, and holographic imaging. An exact representation of the homogeneous Green's function originates from the field of optical holographic imaging (Porter, 1970, JOSA). In this representation, the homogeneous Green's function between two points A and B is expressed as an integral along an arbitrary boundary enclosing A and B. This implies that the Green's function between A and B can be retrieved from measurements carried out at a closed boundary, or, via reciprocity, from passive observations at A and B of the responses to sources on a closed boundary. In practical situations, the closed-boundary integral usually needs to be approximated by an open-boundary integral. This can lead to significant artifacts in the retrieved Green's function. I will discuss a new, single-sided, representation of the homogeneous Green's function, which obviates the need for omnidirectional access. Like the classical closed-boundary representation, this new single-sided representation fully accounts for multiple scattering. I will indicate applications of this new representation in the aforementioned fields.

11:00

1aUWa2. Fluctuations in the cross-correlation for fields lacking full diffusivity: The statistics of spurious features. richard weaver and John Y. Yoritomo (Phys., Univ. of Illinois at Urbana-Champaign, 1110 w green, Urbana, IL 61801, r-weaver@illinois.edu)

Inasmuch as ambient noise fields are often not fully diffuse the question arises as to how, or whether, noise cross-correlations converge to Green's function in practice. Well-known theoretical estimates suggest that the quality of convergence scales with the square root of the product of integration time and bandwidth. However, correlations from natural environments often show random features too large to be consistent with fluctuations from insufficient integration time. Here, it is argued that empirical seismic correlations suffer in practice from spurious arrivals due to scatterers, and not from insufficient integration time. Estimates are sought for differences by considering a related problem consisting of waves from a finite density of point sources. The resulting cross-correlations are analyzed for their mean and variance. The mean is, as expected, Green's function with amplitude dependent on noise strength. The variance is found to have support for all times up to its maximum at the main arrival. The signal-to-noise ratio there scales with the square root of source density. Numerical simulations support the theoretical estimates. The result permits estimates of spurious arrivals' impact on identification of cross-correlations with Green's function and indicates that spurious arrivals may affect estimates of amplitudes, complicating efforts to infer attenuation.

11:20

1aUWa3. Global propagation of seismic body waves and correlation. Michel Campillo, Lise Retailleau, Pierre Boue, Lei Li (ISTerre, Université Grenoble Alpes, ISTerre, UGA Maison des GéoSci., Grenoble 38041, France, michel.campillo@univ-grenoble-alpes.fr), Piero Poli (EAPS, MIT, Cambridge, MA), and Maarten de Hoop (RICE Univ., Houston, TX)

We discuss the nature of retrieved body waves at teleseismic distances from correlation of records in two separate bands $T<10$ s and $T>30$ s. The short period correlations indicate the presence of deep phases that appear as correct reconstructions of actual phases. We present an example of application to the reflectivity of the core-mantle boundary region. Careful tests show the reliability of the images produced with ambient noise records. On the opposite, we analyze long period records and show that the correlations are dominated by strong coherent phases (with time close to actual ScS or P'P'df) that are the signatures of high quality factor normal modes. By using