9th FTSES 2024 Penghu, Taiwan

9th France-Taiwan Symposium in Earth Sciences
Session: Marine Geology/ Underwater Geophysics

Application of noise interferometry to acoustic characterization of the Coastal Ocean

Tsuwei Tan[1], Oleg A. Godin[2]

[1] Department of Marine Science, ROC Naval Academy, Kaohsiung 81345, Taiwan
[2] Physics Department, Naval Postgraduate School, Monterey, CA 93943, USA

Practical implementations for extracting empirical Green's functions from diffuse noise have been developed across various scientific disciplines. Noise interferometry takes advantage of uncontrolled, spatially distributed noise sources to extract environmental information by cross-correlating acoustic pressure recorded by hydrophone pairs. Empirical estimates of the Green's function are obtained from two-point noise cross-correlation functions (NCCFs), serving as the signal to explore the ocean interior. Each hydrophone pair provides detailed and robust environmental information, achieved using the time warping transform to separate normal mode components of the NCCF and measure their dispersion curves. This methodology has been applied to the data acquired in the Straits of Florida and on the continental shelf off New Jersey. Geoacoustic parameters of the seabed are found from NCCFs evaluated using long averaging times of about 1–2 weeks. Similar averaging times are employed to characterize sub-seasonal variations in the sound speed profile (SSP) in water. In dynamic environments, these sound speed profiles represent time-averaged values. The findings indicate that at ranges of 40–70 ocean depths, NCCFs can be reliably retrieved even with noise averaging times as short as one minute [doi.org/10.1121/10.0023931], implying the potential for real-time passive monitoring of ocean dynamics.

Keywords: Passive Acoustic Monitoring; Ocean Acoustic Remote Sensing; Noise Interferometry, Time Warping; Geoacoustic Inversion; Sound Speed Profile Tomography; Empirical Green's Functions; Normal Modes; Dispersion Curves