Estimating Shapes Of Acoustic Mode Functions Of A Deep Water Waveguide Using Ambient Noise Measurements

Master's Thesis defense
by
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Ocean acoustic tomography is a powerful method that uses sound to study ocean properties such as temperature, which is directly related to sound speed in water. This thesis focuses on using ambient noise to infer the normal modes of the ocean waveguide. The modes are a set of orthogonal functions that are solutions to the depth dependent wave equation, which depends on sound speed and thus on the temperature. Assuming that noise signals received by a vertical array consist of a sum of uncorrelated modes, the modeshapes can be determined from an eigenvector decomposition of the measured cross-spectral density matrix. Several authors have applied this technique to estimate the modes of shallow water waveguides, but there have been few opportunities to apply this technique in deep water waveguides. In this thesis the modeshapes are estimated of a deep water environment in the North Pacific using ambient noise data measured during the SPICE04 experiment. Although noise measurements were not the primary focus of SPICE04, the experiment provided a large data set for this analysis. In addition to acoustic measurements, the experiment also included extensive sampling of the environmental parameters. This thesis summarizes some of the noise statistics measured during 2004-2005. The measured modeshapes derived from the data are compared with the true modes derived from the measured environmental data.