ACOUSTICS2008/2586
Geoacoustic Environment Tracking Using Kalman and Particle Filters

Peter Gerstoft[a], Caglar Yardim[a] and William Hodgkiss[b]
[a]Marine Physical Laboratory, Scripps Institute of Oceanography, 8602 La Jolla Shores Drive, La Jolla, CA 92093-0238, USA
[b]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0225, USA

This paper addresses the problem of tracking the geoacoustic environmental parameters such as the sound speeds in water, sediment and the bottom, sediment attenuation, density and thickness. The tracking is based on using acoustic measurements within an extended Kalman (EKF), unscented Kalman (UKF), and particle filter (PF) framework. The acoustic field is computed using a normal mode code which introduced a varying degree of nonlinearity depending on the environmental parameter of interest. Posterior Cramer-Rao lower bounds (PCRLB) are used to compute the tracking performances of the filters, including the filter efficiencies, divergence statistics, and computational complexities. The results showed that some of the parameters such as the water column parameters can be tracked by Kalman filters, however, the tracking performance of the Kalman filters was limited by the highly nonlinear relation between the sediment/bottom parameters and the acoustic field and non-Gaussian densities of these parameters. Particle filters proved to be very promising in tracking sediment layer parameters, even in the abruptly changing environments.