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Tomographic and bottom geoacoustic inversions using Genetic Algorithms and a statistical characterization of the acoustic signal

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The paper deals with the problem of estimation of the parameters of the water column and/or the sea bed, using measurements of the acoustic field due to a known source at a certain point in the water column. Following the work by Taroudakis et al. (JASA 119, 1396-1405 (2006)) the acoustic signal is characterized using the statistics of the wavelet sub-band coefficients, which obey a certain statistical law, described by an Alpha-Stable distribution. Thus, the signal observables are the set of the parameters of the appropriate distributions at the various levels of the signal decomposition. In this work an inversion procedure based on a Genetic Algorithm and the statistical characterization of the acoustic signal, is described. The quality of a certain population of candidate model parameters (properties of the water columns and/or the sea-bed) is evaluated using the Kullback-Leibler divergence (KLD) of the wavelet sub-band coefficient distributions, between the measured and simulated acoustic signals. Following an appropriate population regeneration procedure, the final population is described by an a-posteriori statistical distribution of the model parameters, indicating among the others their sensitivity in the inversion procedure. Very good inversion results have been observed in simulated shallow water environments.