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Joint Optimization of a Signal Processing Chain for Hydroacoustic Signal Classification

One sub-task in hydroacoustic signal processing for CTBT verification is automatic discrimination of incoming signals by source type. In particular, signals from any explosive-like source should be reliably identified among a wide range of noise (for example, seaquakes, marine mammals, or ship noise). Previous studies have applied rule-based systems, neural network classifiers, support vector machines (SVMs) with task-tailored kernel functions, as well as maximum-margin Bayesian network classifiers to features independently extracted by the current IMS data processing system. In the present contribution, we instead set up and parameterize a full processing chain from signal detection and feature extraction to classification. Its free parameters are optimized according to a single common objective function. Signals are detected by a flexible, generic trigger algorithm operating on the long- to short-term average ratio of the spectral energy. The signals are represented by general sound-processing features, with special focus on spectral and cepstral attributes. Several classifiers are explored, in particular SVMs with different kernel functions. Experiments show that SVMs with radial basis function kernels applied to the output of the optimized processing chain outperform earlier and baseline approaches. In particular, they exhibit 100% sensitivity at high specificity, which is desired for the application at hand.

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