Robust Support Vector Machine Spectrum Estimation in Cognitive Radio

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In cognitive radio, spectrum has to be sensed to determine whether the spectrum is available or it is in use by a licensed user. Often spectrum sensing is challenging due to strong noise and interferences. When interferences do not have Gaussian properties, common Least Squares-based algorithms (from DFT to MUSIC) present poor performance due to the fact that Least Squares is no longer a Maximum Likelihood (ML) criterion under these conditions. We present a technique to estimate spectrum that demonstrates robustness in a variety of strong interference scenarios while Least Squares algorithms fail to produce an accurate spectrum estimation.

The algorithms are based on the well-known Support Vector Machines that use a non-quadratic optimization criterion and that are regularized to produce solutions with good generalization properties. The cost function that is implicitly used in the presented strategy is similar to the Huber robust cost function, and it includes quadratic and linear segments. This cost function makes it approximately ML for small error, i.e. produced by thermal noise, and approximately ML for large errors, i.e. produced by impulse interferences.

In our simulations, data is corrupted by high power impulse plus Gaussian noise, with a 0dB SNR. The spectrum is estimated using our algorithm in combination with the Welch periodogram, and compared with the FFT-Welch periodogram. The noise statistics are such that occasionally, at 0dB SNR, the FFT and the SVR estimates are equally good. However, we will show that SVRs outperform an FFT estimate over the long run.