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MERCURY

Time Frequency Analysis for Single Channel Applications

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The Ultimate Performance Machine

Project Description

Implementation/Demonstration Goals

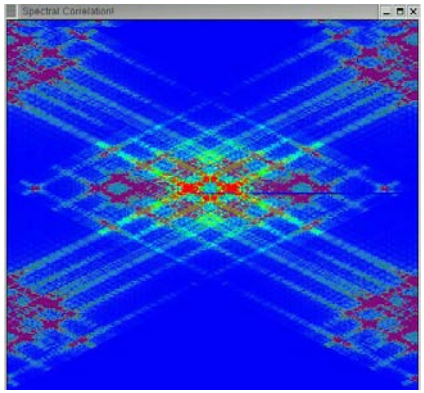
- Choose a selection of compute-intensive signal processing algorithms for demonstration on a real-time multicomputer system
- Some algorithms address problems in signal intercept or passive/active radar applications
- Follow progress of an interesting series of works performed at Naval Postgraduate School [2] (under Prof M. Fargues and former Prof R. Hippenstiel); also follow Time-Frequency toolbox [6].
  - Spectral Correlation Receiver based upon FFT Accumulation Method
  - Continuous Wavelet Transform (Scalogram)
  - Discrete Wigner-Ville Distribution with a selected set of interference-reducing kernels
  - Parallel Filter Bank and Higher Order Statistics detection
    - -- Third order cumulant detector/estimator

Time Frequency Representation (TFR) Overview

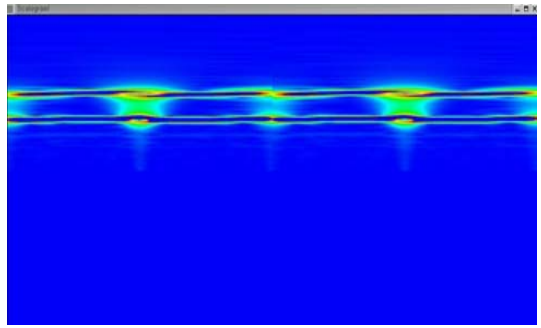
- TFRs are powerful tools to analyze, characterize, and classify dynamic signals existing in non-stationary conditions.
- Certain characteristics such as high resolution measurement of the instantaneous frequency and energy of a signal across time are appealing to practitioners across a wide range of science and engineering disciplines.
- Unfortunately the holy grail of high resolution and co-existence of multiple signals and multiple signal components remains elusive.
- An enormous amount of research focus has gone into obtaining the desirable mathematical properties of the Wigner-Ville Distribution without its accompanying distortion properties for the above conditions.
- Variety of algorithms, kernels, representations, etc. available.
- Many approaches involve high levels of computation, especially the fixes overlaid to overcome deficiencies of a particular technique.

"Waterfall Displays"

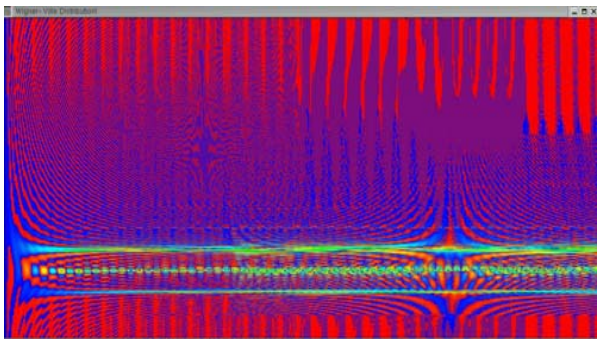
Spectral Correlation



CWT Scalogram



Smoothed Pseudo Wigner-Ville Distribution



Filter Bank with Cumulant Noise Suppression