Exercise Lecture 3

Kernel properties and design in Cohen's class time-frequency distributions

Part 1: Basic exercises

1- Compare the Choi-Williams and Rihaczek distributions for both a double sinusoid and chirp stimulus.

2- What is the determining function? Plot the Rihaczek determining function and the results using 3-D type plots.

3- Construct a signal consisting of two components: a continuous sine wave of 20 Hz and a chirp signal that varies from 20 Hz to 100 Hz over a 0.5 s time period. Analyze this signal using two different distributions: Wigner-Ville and Choi-Williams. Assume a sample frequency of 500 Hz, and use analytical signal.

4- Repeat Problem 3 above using the Born-Jordan-Cohen and Rihaczek distributions.

5- Construct a signal consisting of two sine waves of 20 and 100 Hz. Add to this signal Gaussian random noise having a variance equal to 1/4 the amplitude of the sinusoids. Analyze this signal using the Wigner-Ville and Choi-Williams distributions. Assume a sample frequency of 300 Hz and a 2 s time period. Use analytical signal.

6- Repeat Problem 5 above using a chirp signal that varies between 20 and 100 Hz, with the same amplitude of added noise.

7- Repeat Problem 6 with twice the amount of added noise.

8- Repeat Problems 6 and 7 using the Rihaczek

Part 2: Complementary exercises

1- Download the Time-Frequency Toolbox (TFTB) from http://tftb.nongnu.org/. The Time-Frequency Toolbox is a collection of Matlab files developed for the analysis of non-stationary signals using time-frequency distributions. In the same webpage (on the Documentation section), there is a tutorial with several examples (and insightful explanations) of Joint Time-Frequency Analysis. These examples will provide a deeper understanding on the topics reviewed in the lecture.

2- For Lecture 3, the recommended examples are:

- Chapter 4: Sections 4.1.2, 4.1.3 and 4.1.4.