Supplementary material for TFSAP book Section 13.4: "Fractional Autocorrelation for Detection in Communications"[1]

The additional material[2] in this file is provided by Prof Boashash to assist the reader to better understand and use Section 13.4 of the TFSAP book. The material was collected from the original authors and then edited and standardized by Prof. Boashash. The MATLAB functions and scripts listed below are used to reproduce some of the illustrative figures found in Section 13.4.

MATLAB Functions:

- *fracF*: It computes the ith order fast fractional Fourier transform (FrFT) of a time domain input signal.
- *corefrmod2*: It computes the FrFT of an input signal for an order ranging from 0.5 up to 1.5.
- *bizinter*: It interpolates/up-samples an input signal to double its length.
- *bizdec*: It decimates/down-samples an input signal to half its length.

MATLAB Scripts:

Figure_13_4_1.m

- Description: This script produces results that are close to the ones depicted in Fig. 13.4.1, on page 775 of the book.
- Process: It generates a mono-component chirp signal with a sweep rate of 0.35, and then corrupts it with multiple additive complex noise waveforms to produce three noisy signals with different SNRs. After that, it calculates the normalized statistics for the noise-free and the corrupted signals, using the FrFT of the signals. Finally, it quantifies the performance of the sweep rate estimator using the mean square error (MSE) metric.

Figure_13_4_2.m

- Description: This script produces results that are close to the ones depicted in Fig. 13.4.2, on page 776 of the book.
- Process: It generates a four-component chirp signal with different sweep rates, and then corrupts it with multiple additive complex noise waveforms to produce three noisy signals with different SNRs. After that, it calculates the normalized statistics,

[1] O. Akay and G.F. Boudreaux-Bartels, "Fractional Autocorrelation for Detection in Communications", Chapter 13.4; in B. Boashash (ed.), *Time-Frequency Signal Analysis and Processing*, 2nd Edition (London: Elsevier / Academic Press, pages 770-777, December 2015); ISBN 978-0-12-398499-9.

[2] All of the book supplementary materials can be found here.

for the noise-free and the corrupted signals, using the FrFT of the signals. Finally, it quantifies the performance of the sweep rate estimator using the MSE metric.

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