Supplementary material for TFSAP book Section 12.4: "Time-Frequency Methods for Signal Estimation and Detection"[1]

The additional material in this file is provided by Prof Boashash to assist the reader to better understand and use Section 12.4 of the TFSAP book. The reader may benefit from accessing the code and/or other supplementary materials (SM)[2] from the following related Chapters of the book: 11.3, 11.5, 12.5, 8.1, 2.1.3, 2.1.4, 2.3.1, 17.3.3 and 17.3.5 as detailed below.

1. Related Supplementary Material in Chapters 11.3 and 11.5:

Time-varying Wiener filtering is utilized in Chapters 11.3 and 11.5 for different applications. In Chapter 11.3, it is utilized for an application involving hands-free telephone speech signals. Figs. 11.3.1 and 11.3.2, on page 661 of the book, illustrate time-frequency (*t*, *f*) representation of noisy and denoised signals after the filtering operation. Run the MATLAB script *speech_time_varying_filtering.m*, provided in the SM of Chapter 11.3, to reproduce the results.

Furthermore, Chapter 11.5 illustrates a performance comparison, in Table 11.5.1 and Fig. 11.5.6 on pages 676 and 677 of the book, between the time-varying Wiener filter and subspace noise filtering for different synthetic noisy signals with variant SNRs. Run the MATLAB script *Sec_11_5_Figure_6.m*, provided in the SM of Chapter 11.5, to reproduce the results that are depicted in Fig. 11.5.6.

2. Related Supplementary Material in Chapter 12.5:

Optimal detection of nonstationary signals using Time-Frequency Matched Filters (TFMF) is explained in Chapter 12.5. Run the MATLAB scripts, *Fig_1.m* to generate similar results to the ones depicted in Fig. 12.5.1, on page 728 of the book, which illustrates EEG seizure and non-seizure activities, and *Call_functions_script.m* to generate similar results to the ones depicted in Table 12.5.2, on page 730 of the book, which shows the AUC scores for detecting seizures in multichannel newborn EEG.

3. Related Supplementary Material in Chapter 8.1:

Signal estimation and detection using spatial time-frequency distributions (STFDs), is discussed in Chapter 8.1. Run the MATLAB script *Time_Freq_MUSIC_Main_Avg.m* to regenerate Fig. 8.1.10 on page 465 of the book. It illustrates the direction of arrival estimation of two sources emitting Linear Frequency Modulated (LFM) signals.

4. Related Supplementary Material in Chapters 2.1.3 and 2.1.4:

Formulations of the Wigner and the Wigner-Ville distributions are presented in Chapters 2.1.3 and 2.1.4 and illustrated in Figs. 2.1.1 and 2.1.2 on pages 68 and 69 of the book.

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[1] B. Boashash, Ed., "Time-Frequency Methods for Signal Estimation and Detection", Supplementary material for Chapter 12.4; in B. Boashash (ed.), *Time-Frequency Signal Analysis and Processing*, 2nd Edition (London: Elsevier / Academic Press, pages 716-724, December 2015); ISBN 978-0-12-398499-9.

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

Run the MATLAB scripts *WVD_lfm_signal.m* and *WD_and_WVD.m* to reproduce the results.

5. Related Supplementary Material in Chapter 2.3.1:

The short time Fourier transform (STFT) and the spectrogram (squared magnitude of the STFT) are defined in Chapter 2.3.1. See Figs. 2.3.1 and 2.3.2, on pages 78 and 79 of the book, which illustrate the spectrogram of a sinusoidal frequency modulated and an LFM signals. Run the MATLAB scripts *Spec_SIN_FM.m* and *Spec_LFM.m* to reproduce the results. The STFT of a time-domain signal can be computed by accessing the functionalities of the TFSAP Toolbox[3] either by using the Toolbox GUI model or by using the MATLAB command window (see Section 17.4.5 of the guide document for the SM of Chapter 17). For more details, see help for the STFT by typing `help stft` in the MATLAB command window after adding the toolbox to the MATLAB path.

6. Related Supplementary Material in Chapter 17.3.3:

Simulated and real time-domain signals can be generated by accessing the TFSAP Toolbox functions either by using the GUI model or by using the MATLAB command window (see Section 17.3.3 of the guide document for the SM of Chapter 17).

7. Related Supplementary Material in Chapter 17.3.5:

Quadratic Time-Frequency distributions, e.g. the WVD and the Spectrogram, of a time-domain signal can be computed and plotted by accessing the functionalities of the TFSAP Toolbox either by using the GUI model or by using the MATLAB command window (see Section 17.3.5 of the guide document for the SM of Chapter 17).

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[3] TFSAP Toolbox can be found here.