Supplementary material for TFSAP book Section 12.3: "System Identification using Time-Frequency Filtering"[1]

The additional material in this file is provided by Prof Boashash to assist the reader to better understand and use Section 12.3 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, 11.6, 4.11, 11.2, 17.4.3, 17.3.3, and 17.3.5 as detailed below.

1. Related Supplementary Material in Chapters 11.3, 11.5 and 11.6:

Different time-frequency *(t, f)* filtering methods are discussed in Chapters 11.3, 11.5, and 11.6. In Chapter 11.3, a time-varying filter is designed for an application involving hands-free telephone speech signals. Figs. 11.3.1 and 11.3.2, on page 661 of the book, illustrate the *(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.

In addition, subspace noise filtering using *(t, f)* distributions (TFDs) is discussed in Chapter 11.5. Run the MATLAB script *Sec_11_5_Figures1_to_5.m*, provided in the SM of Chapter 11.5, to produce results that are close to the ones depicted in Figs. 11.5.1-11.5.5, on pages 671 and 673-675 of the book.

Moreover, two *(t, f)* other filtering methods for speech enhancement are discussed in Chapter 11.6. Run the MATLAB script *Test_algorithms.m* to generate a similar example to the one illustrated in Figs. 11.6.2 and 11.6.3, on pages 686-687 of the book.

2. Related Supplementary Material in Chapters 4.11 and 11.2:

Figs. 4.11.1 and 4.11.5, on pages 220 and 223 of the book, illustrate the Gabor spectrogram of two parallel linear frequency modulated signals and a test signal.

Run the MATLAB scripts *TFSAP_SUP_MAT_CHAP_4_11_GabSpecWVD.m* to reproduce Fig. 4.11.1 and *TFSAP_SUP_MAT_CHAP_4_11_ASpec_and_GabSepc.m* to reproduce Fig. 4.11.5.

Furthermore, a time-varying filter is discussed in Chapter 11.2 using the short time Fourier transform (STFT) and the Gabor expansion. Run the MATLAB script *ScriptResults.m*, provided in the SM of Chapter 11.2, to generate similar results to the ones depicted in Fig. 11.2.2, on page 652, which illustrates filtering of a speech signal using the inverse STFT. This material has been extended and published in the following article:

Ouelha, S., Touati, S., & Boashash, B. "An efficient Inverse Short-Time Fourier Transform Algorithm for Improved Signal Reconstruction by Time-frequency Synthesis: Optimality and computational issues". *Digital Signal Processing*. 65, 81-93. (2017).

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[1] B. Boashash, Ed., "System Identification using Time-Frequency Filtering", Supplementary material for Chapter 12.3; in B. Boashash (ed.), *Time-Frequency Signal Analysis and Processing*, 2nd Edition (London: Elsevier / Academic Press, pages 708-716, December 2015); ISBN 978-0-12-398499-9.

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

3. **Related Supplementary Material in Chapter 17.4.3:**

Time-frequency filtering techniques, using the TFSAP toolbox[3], are discussed in Chapter 17.4.3.

Noise suppression using the Wigner-Ville Distribution and the STFT are explained in Chapters 17.4.3.1 and 17.4.3.2 (see Fig. 17.4.9 on page 985 of the book).

4. **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 Readme document for the SM of Chapter 17).

5. **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 Readme document for the SM of Chapter 17).

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[3] TFSAP Toolbox can be found here.