

# Supplementary Material for Chapter 15: “Time-Frequency Diagnosis, Condition Monitoring, and Fault Detection”<sup>1</sup>

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The zip files contained in this directory contain the supplementary materials<sup>2</sup> (SM) for each Section of the Chapter separately. The user is advised to review the read-me file for each Section to get a good overview of the contents of its SM. Below is a brief overview of the Chapter in the book. Part 2, next page, is the actual inventory of the SM provided for this chapter.

## 1. Book Chapter SM Overview:

This chapter aims to further illustrate the time-frequency  $((t, f))$  approach by selecting a few key generic applications of diagnosis and monitoring. The topics for which SM is available are described below.

One key application is electrical power quality as it is often severely affected by transient disturbances. It is necessary to detect and assess their effect on voltage and current stability (15.1: see page 2). In addition, in the automotive industry, the treatment and prevention of knock is a major problem for internal combustion engines as car spark knocks caused by an abnormal combustion may lead to engine damage. The Wigner-Ville distribution is used to optimize the position for placement of knock sensors (15.2: see page 2). In applications of image processing, image quality may be assessed using a 2D-WVD based measure correlated with subjective human evaluations. It is shown that this SNR measure based on the WVD outperforms conventional SNR measures (15.4: see page 2). Some general principles of  $(t, f)$  diagnosis are then reviewed for medical applications with focus on heart sound abnormality diagnosis (15.5: see page 2). For machine condition monitoring, a task crucial to the competitiveness of a wide range of industries, the tasks of detecting and diagnosing faults in machines is made easier using machine learning methods with  $(t, f)$  approaches such as the WVD, wavelets and wavelet packets (15.6: see page 2).

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<sup>1</sup> B. Boashash (ed.), Time-Frequency Signal Analysis and Processing, 2nd Edition (London: Elsevier / Academic Press, December 2015); ISBN 978-0-12-398499-9.

<sup>2</sup> All of the book supplementary materials can be found [here](#).

## 1. Book Chapter SM Main Script Inventory:

Supplementary material	Brief Description
<i>Section 15.1: Time-Frequency Analysis of Electric Power Disturbances</i>	
<i>SM_15_1.m</i>	This script elaborates the usefulness of time-frequency methods in analyzing power system disturbances.
<i>Section 15.2: Combustion Diagnosis by TF Analysis of Car Engine Signals</i>	
<i>Figure_15_2_1.m</i>	This script reproduces the results that are depicted in Fig. 15.2.1, on page 866 of the book.
<i>Figure_15_2_2.m</i>	This script reproduces similar results to the ones that are depicted in Fig. 15.2.2, on page 868 of the book.
<i>Figure_15_2_3.m</i>	This script produces similar results to the ones that are depicted in Fig. 15.2.3, on page 870 of the book.
<i>Section 15.4: The 2D Wigner-Ville Distribution Applied to Image Distortion Estimation</i>	
<i>snr_w_01.m</i>	This script produces close results to the ones that are depicted in Fig. 15.4.1, on page 885 of the book.
<i>Section 15.5: Extracting Time- Frequency Features from PCG Signals for Medical Diagnosis</i>	
<i>Sec_15_5_EMBD_code.m</i>	This script produces the results that are depicted in Figs. 15.5.2-15.5.4, on page 891-893 of the book.
<i>Section 15.6: Diagnosis and Condition Monitoring Using Time-Frequency Pattern Recognition and Machine Learning</i>	
<i>figure15_6_3.m</i>	This script produces the results that are depicted in Fig. 15.6.3, on page 902 of the book.

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