

# Supplementary Material for Chapter 13: “Time-Frequency Methods in Communications”<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 read 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:

The wide range of potential applications of time-frequency  $((t, f))$  methods made them an important tool in most fields of science and engineering. Telecommunications is one of the key industries where  $(t, f)$  methods started playing an important role. The topics for which SM is available are described below.

Broadband communication platforms use spread spectrum technology to mitigate jamming by interference excision. Distributing the signature of received data over a  $(t, f)$  region, can be minimized by  $(t, f)$  methods (13.1: see page 2). In wireless communication systems with Code Division Multiple Access (CDMA) protocol, fading and multi-access interference can be dealt with using time-frequency processing. A  $(t, f)$  RAKE receiver is described which implements correlations in the  $(t, f)$  domain and accounts for both spectral and temporal channel variations resulting from the use of spread spectrum techniques (13.2: see page 2). Eigenfunctions of linear systems can be modeled by signals with a well localized  $(t, f)$  distribution. The knowledge of the Eigenfunctions of time-varying transfer functions allows optimizing the transmission strategy to take advantage of the channel dispersive properties (13.3: see page 2). Detection and parameter estimation of chirps in communication systems may be implemented using the fractional Fourier transform, i.e. a non-standard FT where  $2\pi$  is replaced by a smaller angle  $\phi$  (13.4: see page 2). The other section focuses on the  $(t, f)$  estimation of radio signal modulation parameters and includes a discussion on cognitive radio, quality of service and communication channels from a  $(t, f)$  perspective (13.5: 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](#).

## 2. Book Chapter SM Main Script Inventory:

Supplementary material	Brief Description
<i>Section 13.1: Time-Frequency Interference Mitigation in Spread Spectrum</i>	
<i>SM_Sec_13_1.m</i>	This script produces a similar example that is close to the one depicted in Fig. 13.1.3, on page 752 of the book.
<i>Section 13.2: Communication Over Linear Dispersive Channels, A Time-Frequency Perspective</i>	
<i>SM_Sec_13_2</i>	This script produces results that are similar to the ones depicted in Fig. 13.2.1(a), on page 759 of the book.
<i>Section 13.3: Eigenfunctions of Underspread Linear Time-Varying Systems</i>	
<i>Example_1.m</i>	This script produces results that are similar to the ones depicted in Fig. 13.3.2, on page 765 of the book.
<i>Example_2.m</i>	This script produces results that are similar to the ones depicted in Fig. 13.3.4, on page 767 of the book.
<i>Section 13.4: Fractional Autocorrelation for Detection in Communications</i>	
<i>Figure_13_4_1.m</i>	This script produces results that are close to the ones depicted in Fig. 13.4.1, on page 775 of the book.
<i>Figure_13_4_2.m</i>	This script produces results that are close to the ones depicted in Fig. 13.4.2, on page 776 of the book.
<i>Section 13.5: Time-Frequency Estimation of Radio Signal Modulation Parameters</i>	
<i>Fig_13_5_2.m</i>	This script produces the results depicted in Fig. 13.5.2, on page 781 of the book.
<i>Fig_13_5_3.m</i>	This script produces the results depicted in Fig. 13.5.3, on page 782 of the book.
<i>Fig_13_5_4.m</i>	This script produces the results depicted in Fig. 13.5.4, on page 783 of the book.
<i>Fig_13_5_6.m</i>	This script produces the results depicted in Fig. 13.5.6, on page 785 of the book.
<i>Fig_13_5_8.m</i>	This script produces the results depicted in Fig. 13.5.8, on page 787 of the book.

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