Time-Frequency Signal Analysis with Applications
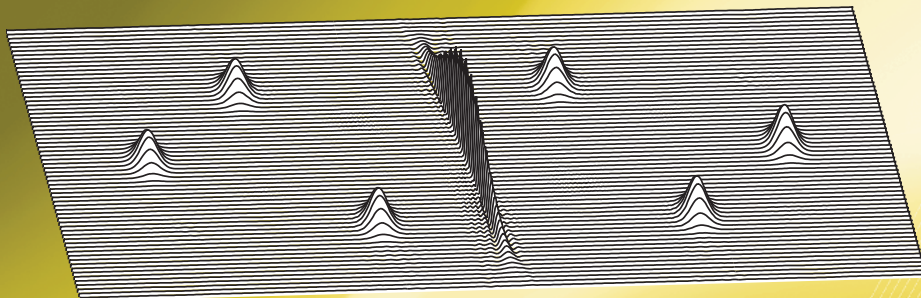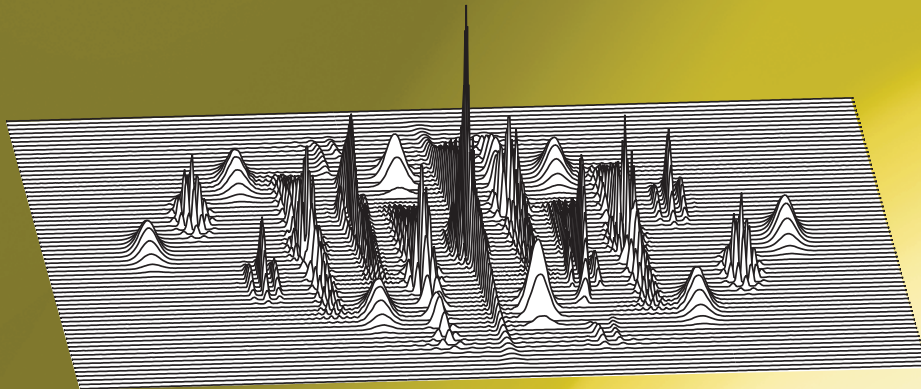
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Time-Frequency Signal Analysis

with Applications

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Contents

Preface

This book is a result of more than twenty years of research and education in the area of time-frequency signal analysis and signal theory, in general.

The book presents time-frequency analysis, which is of crucial interest to a variety of researchers, students, and engineers dealing with any aspects of signal processing in their work. It deals with the theory, concepts, and applications of time-frequency analysis being at the core of some new technologies used in most fields of engineering, science, and technology, like information technologies, radar and sonar signal processing, biomedicine, multimedia, telecommunications, seismology, car engine technology, and optics.

After publishing several research monographs the authors concluded that there was a need for a textbook that could be used by students, researchers, and engineers who want to apply time-frequency tools in their work. Time-frequency analysis has been regarded as a part of advanced graduate courses on signal processing.

This book begins with the basic concepts needed to understand time-frequency techniques. An overview of Fourier analysis, presenting relations among the Fourier transform, the Fourier transform of discrete-signals, the Fourier series, and the discrete Fourier transform, is given. The sampling theorem is discussed as well. Next the book focuses on advanced techniques and methods needed for the analysis and processing of signals with time-varying spectral content. Chapter 2 deals with time localization of the spectral content of signals. The short-time Fourier transform is presented as the basic linear tool for the time-frequency analysis. Other linear signal transformations used for localization of the signal content in the time-frequency domain, including the local polynomial Fourier transform, the fractional Fourier transform, and their generalizations are studied as well.

Quadratic time-frequency distributions is the topic of Chapter 3. The Wigner distribution, as the basic quadratic distribution, is presented in detail. The generalized form of quadratic distributions, known as the Cohen class of distributions, is studied. This chapter concludes with a short overview of other approaches used for signal localization, such as time-scale distributions, empirical mode decomposition, and the reassignment method. Higher-order distributions are presented in Chapter 4. Their properties are studied along with various methods for construction and realization of highly concentrated distributions. Methods used for higher-order non-stationary signal analysis, such as higher-order ambiguity function methods, are also presented here. The noise analysis and instantaneous frequency estimation are considered in Chapter 5. An efficient algorithm for the adaptive analysis of noisy signals is presented. Robust forms of time-frequency representations are analyzed. This chapter ends with a presentation of some methods in time-frequency analysis of sparse signals.

The book concludes with numerous applications, including but not limited to radar signal processing, communications, movement analysis in video sequences, car engine data analysis, multidimensional signal analysis, watermarking in the time-frequency domain, array signal processing, and high-resolution time-frequency methods. Special attention has been paid to the radar signal analysis, due to the authors' intensive research work in this area during the last several years. The presentation of material is supported by numerous examples in each chapter and problems at the end. Problems sometimes cover several areas within one chapter. MATLAB codes of the most important methods and examples are included as well. The initial versions of all chapters in the book were written by Ljubiša Stanković.

Sample chapter can be downloaded from the publisher site

http://www.artechhouse.com/static/sample/Stankovic-651_CH05.pdf

http://www.artechhouse.com/International/Books/
TimeFrequency-Signal-Analysis-with-Applications-2015.aspx

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