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# Time-Domain Ultra-Wideband Radar, Sensor and Components

Theory, Analysis and Design



Springer

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# Preface

Impulse-based ultra-wideband (UWB) system or, in short, UWB system is a unique system possessing many desired characteristics, owing to the transmission and reception of only a single signal having pulse waveform at all times, rather than multiple consecutive CW signals having sinusoidal waveform at different times as in CW-based systems. This unique operation is equivalent to transmitting and receiving many CW signals across an extremely broad bandwidth concurrently. In other words, an UWB system is electrically equivalent to multiple CW systems, each operating at a single frequency in an ultra-wide bandwidth, working simultaneously. It is this unique operation that makes the UWB system distinctly different from the CW systems, not only in the design and performance, but also in some applications—some of which are not even possible with CW systems. UWB systems find numerous applications for military, security, civilian, commerce, and medicine. UWB systems are suitable for both high resolution and long range, but they are particularly attractive for high-resolution sensing applications.

This book is devoted to the theory, analysis and design of UWB systems and their components. Particularly, it covers the main topics of UWB systems that are system analysis, transmitter design, receiver design, antenna design, and system integration and test. It also presents the design of a specific practical UWB system and its constituent components of transmitter, receiver, antenna, signal processing, integration, and test, which serve as an effective way to demonstrate not only the analysis, design, and applications of UWB systems, but also the analysis and design of constituent components. Although the book is succinct, the material is very much self-contained and contains practical, valuable and sufficient information presented in such a way that allows readers with an undergraduate background in electrical engineering or physics, with some experiences or graduate courses in microwave circuits, to understand and design easily UWB components, transmitters, receivers, and systems for various applications.

The book is useful for engineers, physicists, and graduate students who work in radar, sensor, and communication systems as well as those involved in the design of microwave circuits and systems. It is our sincere hope that the book can serve not only as a reference for the development of UWB systems and components, but also

for a new generation of innovative ideas that can benefit many existing sensing and communication applications or be implemented for other new applications.

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