Wavelet Radio

Adaptive and Reconfigurable Wireless Systems Based on Wavelets

The first book to provide a detailed discussion of the application of wavelets in wireless communications, this is an invaluable source of information for graduate students, researchers, and telecommunications engineers, managers and strategists. It surveys applications, explains how to design new wavelets, and compares wavelet technology with existing OFDM technology.

- Addresses the applications and challenges of wavelet technology for a range of wireless communication domains
- Aids in the understanding of wavelet packet modulation and compares it with OFDM
- Includes tutorials on convex optimisation and spectral factorisation for the design of wavelets
- Explains design methods for new wavelet technologies for wireless communications, addressing many challenges, such as peak-to-average power ratio reduction, interference mitigation, reduction of sensitivity to time, frequency and phase offsets, and efficient usage of wireless resources
- Describes the application of wavelet radio in spectrum sensing of cognitive radio systems.

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Preface

Wavelets provide promising potential applications in wireless communication. The main property of wavelets for these applications is their ability and flexibility to characterize signals with adaptive time–frequency resolution. The convergence of information, multimedia, entertainment and wireless communications has raised hopes of realizing the vision of ubiquitous communication. To actualize this, there is a challenge of developing technologies and architectures capable of handling large volumes of data under severe constraints of resources such as power and bandwidth. Wavelets are uniquely qualified to address this challenge. They have strong advantage of being generic schemes whose actual characteristics can be widely customized to fulfil the various requirements and constraints of advanced mobile communications systems. The wavelet technology is the choice for smart and resource aware wireless systems.

In the light of this, the objective of this book is to utilize the wavelet technology for smart and resource aware radio systems and to develop wavelet based radio systems that cleverly and efficiently use available resources to guarantee the required quality of service. Adaptation, smartness, context aware, robustness and reconfigurability are the major accents of wavelet radio, which will be concentrated on in this book. This is actualized by developing a wavelet-packet-based multi-carrier modulation radio that can be adaptively reconfigured to operate under different use cases even while maximizing resource utilization.

In a recent paper in the IEEE Communication magazine, Steve Weinstein [1], a pioneer in the development of OFDM, traces back the journey of OFDM right from its inception in 1966 when Chang [2] published the first paper on multi-carrier modulation, to the development of the first proof of concept by Bell Labs in 1985 [3] and its first major consumer deployment as ADSL in 1993 and finally its standardization as IEEE 802.11a in 1999. And in his concluding remarks he advocates wavelet based systems as true successors of OFDM, especially for the development of futuristic low power "Green Radios" which are intelligent and adaptable.

The research and investigation on the utilization of wavelet technology for smart resource aware radio systems as presented in this book, not only aims at tackling the various technical questions that will shorten the development time from conception to practical realization of wavelet radios (vis-à-vis the OFDM cycle which took close to 35 years), but also to give the wireless radio research community a lead in this exciting new line of research. Furthermore, in an era when bold predictions that the *PHY Layer is*

Dead [4] are made, the work on wavelet radio will increase the capacities of the wireless link and open new vistas for an exciting line of research topics on radio design.

The book addresses the physical layer challenges of wavelet radio transmission and is organized in eight chapters. The material is categorized into three broad divisions, namely, theoretical background (Chapters 1, 2), wavelet radio (Chapters 3–5) and wavelet applications in cognitive radio design (Chapters 6 and 7). Finally, the book rounds off in Chapter 8 with conclusions and recommendations for future research. I would greatly appreciate the readers' comments on this work; collaboration and cooperation will leverage the knowledge of the research community.

References

[1] S.B. Weinstein, "Introduction to the History of OFDM," IEEE Communications Magazine, November 2009, Volume 47, No. 11.
[2] R.W. Chang, "High-Speed Multichannel Data Transmission with Bandlimited Orthogonal Signals," Bell Sys. Tech. J., vol. 45, Dec. 1966, pp. 1775–96; see also U.S. Patent 3,488,445, Jan. 6, 1970.
[3] "A Brief History of OFDM", 2010, Web link: http://www.wimax.com/commentary/wimax_weekly/sidebar-1-1-a-brief-history-of-ofdm.
[4] Panel Discussions at IEEE 69th Vehicular Technology Conference (VTC-Spring), April 2009, Barcelona, Web link: http://www.ieeevtc.org/vtc2009spring/panels.php#Panel02.

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