

## Introduction

The interplay between theory and applications in harmonic analysis has been a source of tremendous progress over the past few decades, joining mathematicians, engineers of all stripes, cognitive scientists, earth scientists, and others in an outpouring of creativity. Indeed, by some accounts, our current notion of wavelets dates back to work done by Jean Morlet to help Elf-Aquitaine find oil. Thus, when Charles Chui asked us to put together a special issue of *Applied and Computational Harmonic Analysis* on wavelet applications in engineering, we were very excited by the possibilities. As *ACHA* has long served as an important bridge between the theoretical and applied realms of harmonic analysis, we saw the special issue as a wonderful opportunity to bring some of the best wavelet-related work in applied areas before the more theoretical side of the community. Our goal in putting together the issue was to assemble a collection of papers that presented the reader with new applications, or raised interesting theoretical questions and stimulated further research, or both. We challenged potential authors to send us work with intriguing theoretical underpinnings.

Given the large volume of interesting wavelet-related research in signal processing, we decided to make our task more manageable by focusing the issue primarily on applications to digital multimedia, an area of particular interest to many researchers. We defined the topic broadly, to include such areas as signal acquisition, transmission (including network and wireless communications), denoising, independent components analysis, signal interpretation, compression, and rights management.

The papers for the special issue were all invited. We called upon dozens of colleagues for their recommendations of the best work on our chosen topic, and their response was overwhelming. Far more interesting research projects were suggested than could fit in a single issue of *ACHA*. Fortunately, the editors of *ACHA* have allowed us a second issue. Even with the additional space, there were many meritorious ideas we were unable to include.

This first special issue begins with an expository work by Anna Gilbert that outlines wavelet-based analytical tools that have proven particularly useful in analyzing network traffic. Next we have a paper by Goyal, Kovacevic, and Kelner that examines the application of overcomplete frame expansions to protection against errors from network packet losses. The paper raises a number of interesting questions on the construction of frames for this purpose. In many applications it is important to use a wavelet decomposition that is invariant to signal shifts in time or space. The paper by Kingebury presents a dual-tree construction of wavelet decompositions that generates complex-valued wavelets that are essentially shift-invariant. Efficient signal coding is an important problem in multimedia. The paper by Vaidyanathan and Akkarakaran provides a thorough overview of the use of transforms and filter banks in signal coding, showing that in many applications, principal component filter banks offer optimal encoding performance. The last paper by Xu, Xiong, Li, and Zhang presents a new design for a wavelet video coder, using three-

dimensional wavelet decompositions, which lead to better performance than the current state-of-the-art video coders based on block transforms.

In the second special issue, to appear in July 2001, we will have five additional papers, covering several interesting topics: using wavelets for computation of optic flow, finding singularities in seismic imaging, analyzing and modeling of natural images, and using multiscale techniques for image enhancement and for analysis and control of traffic in data networks.

We would like to extend our sincere thanks to the authors, not only for their excellent contributions, but also for helping us in reviewing and improving the papers. We hope you will enjoy reading this issue at least as much as we enjoyed putting it together.

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Guest Editors