EE-274 - INTRODUCTION TO WAVELETS & FILTER BANKS

Spring Semester 2004

Introduction to Wavelets is being offered during Spring Semester 2004. Because of the vast interest in this subject, which cuts across traditional scientific boundaries, the course is designed to accommodate students in mathematics, statistics, computer science, physics and of course, engineering. What the student should have is some background in Fourier theory and convolution. What the student should bring to the course is a strong interest in seeing the resolution of problems by methods beyond the Fourier domain.

To ensure that all students are familiar with basic Digital Signal Processing concepts, the first 2 to 3 weeks of the course will consist of a tutorial on this subject. After that, we move to multiresolution ideas.

At the present time, almost every activity in signal processing, from CD music, cellular phones, medical instruments, biomedical imaging, optical technology, computer graphics, to turbulence flow to the study of large-scale distribution of galaxies is presently being studied in the context of wavelets. In image coding, wavelet based coding methods already outperform current *JPEG* standards.

This course will provide both a mathematical background in wavelets and an introduction to their discrete-time implementation. It will illustrate the rich interplay between the mathematical analysis of wavelets and their real-world application to some of the central problems in modern technology. It should also provide an answer to the following questions: What advantages do wavelets have over other spectral techniques such as the DFT (FFT)? How do you choose wavelets? Should you use the Discrete Wavelet Transform or the Continuous Wavelet Transform? How do you "choose the best wavelet basis"?

TOPICS:

Week 1.	Review of basic concepts in discrete-time signal processing
Week 2.	Review of basic concepts in discrete-time signal processing
Week 3.	Discrete-time Fourier transform, discrete-time Fourier series, discrete Fourier transform
Week 4.	Time frequency representations; uncertainty principle
Week 5.	Haar and Sinc expansion of discrete-time signals
Week 6.	Series expansions of continuous-time signals
Week 7.	Multiresolution concepts
Week 8.	Perfect reconstruction filter banks
Week 9.	Orthogonal filter banks
Week 10.	Bi-orthogonal filter banks

Week 11. Wavelets from iterated filters banks
Week 12. Computing scaling function and wavelets by recursion
Week 13. Application to signal processing problems

Textbooks:

1. Wavelet Transforms, Introduction to Theory & Applications, R.M.Rao and A.S.Bopardikar, Addison-Wesley, 1998
2. Wavelets & Filter Banks, Gilbert Strang and Truong Nguyen, Wellesley-Cambridge Press, 1995

The 3 credit hour course, is presently scheduled for Tu, Th, 8:00 to 9:15 a.m., but that time may be changed. Course prerequisite is EE-171. Please contact Professor Mirchandani for additional details.

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