Computational and Applied Mathematics 4345 – Topics in Applied Mathematics

(Topic for Fall 2009 – Discrete Wavelets)

Student Learning Outcomes

1. **Students will demonstrate factual knowledge.** Students will be able to describe and demonstrate by examples the steps involved in basic signal and image compression, such as transforming, quantizing, and encoding.

2. **Students will be able to describe the fundamental principles involved in wavelet transformations.** Students will be able to apply definitions and basic principles to derive identities for Fourier series, compute convolutions, construct low-pass and high-pass wavelet filters, and construct orthogonal wavelet filter banks

3. **Students will apply course material to solve problems.** Students will be able to implement MATLAB algorithms for forward and inverse wavelet transforms and for computing quantitative measures such as entropy and cumulative energy.

4. **Students will develop specific skills, competencies, and thought processes sufficient to support further work in this or related fields.** Students will be able to produce high-quality technical documents incorporating text, MATLAB code, and graphics, that detail the results of problems related to the study of wavelet transformations and their applications.

Textbook

Discrete Wavelet Transformations: An Elementary Approach with Applications, by Patrick J. Van Fleet, Wiley, 2008, ISBN: 978-0-470-18311-3

Course Content

1. vectors, inner products, norms, basic matrix theory, block matrix arithmetic

2. basics of grayscale digital images, color images and color spaces, histogram equalization, entropy, cumulative energy, peak signal-to-noise ratio, Huffman encoding

3. algebra of complex numbers, complex exponential functions, Fourier series, convolution, filters

4. the Haar and Daubechies wavelet transformations

5. MATLAB applications