MATH 772–001 (Wavelet Theory)
Fall 2011

Instructor: David Walnut
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Course web page: Access through `http://math.gmu.edu/coursehomepages.htm`
Office hours: TR 3:00–4:30pm and by appointment.
Text: D. Walnut, *An Introduction to Wavelet Analysis*, Birkhäuser Boston (2001). ISBN 0-8176-3962-4.
K. Gröchenig, *Foundations of Time-Frequency Analysis*, Birkhäuser Boston (2001). ISBN 0-8176-4022-3.

Prerequisites:

MATH 315 or equivalent. Some knowledge of Fourier Analysis and Functional Analysis is required. We will review these concepts at the beginning of the semester. The required Fourier Analysis is covered in the first few chapters of the Walnut book. Familiarity with MATLAB will also be assumed.

Topics:

The goal of the course is to introduce the student to some of the basic concepts, constructions and applications of time-frequency decompositions including wavelet bases and Gabor frames. The schedule below may change as circumstances warrant.

Week 1:	Review of Orthonormal Bases in Hilbert Spaces and Fourier Analysis
Week 2:	Wavelet Orthonormal Bases for $L^2(\mathbf{R})$
Week 3:	Multiresolution Analysis
Week 4:	Filter Banks and the Discrete Wavelet Transform
Week 5:	Daubechies Wavelets
Week 6:	Application to Image Compression
Week 7:	Wavelets in Higher Dimensions with Matrix Dilations
Week 8:	Examples of Higher Dimensional Wavelets
Week 9:	Composite Dilations and Shearlets
Week 10:	Frames and Riesz Bases in Hilbert Space
Week 11:	Gabor Systems: Existence and Basic Properties
Week 12:	Gabor Systems: Duality and Density
Week 13:	The Zak Transform and the Balian-Low Theorem
Week 14:	Project Presentations

Grading:

The grade will be based on homework assignments, and on a semester project of the student's own choosing to be presented at the end of the semester. Details on the project will be forthcoming but will basically consist of an exposition of an approved (by the instructor), recent (meaning published in 2000 or later) research paper in the area of wavelets, Gabor systems, or time-frequency analysis, of the student's own choosing. Following the choice of the paper, a formal project proposal will be made and approved.