

# Frames and Riesz Bases in Harmonic Analysis - Fall 2007

## Final Projects

The course grade will be based on your final project.

### *Task*

To read and report on a mathematics, engineering or scientific research paper (or collection of papers) that uses frames. Your report must connect our class material on frames to the goals and methods of the research paper.

### *Format*

Students should work in teams of two. After reading and understanding the research paper, you will prepare a 2 page summary of its main points and notation, to be distributed as a handout to the rest of the class when you give your oral presentation. Note that both students of the team must speak during the oral presentation, which should last 20-25 minutes.

I strongly advise against using a "Powerpoint" type presentation with lots of pages; instead, focus on the main points and present them as simply as you can.

Presentations will take place during the final week of class, and during some additional sessions in exam week.

### *Steps*

1. Find a partner.
2. Examine some possible papers (estimate: 3 hours), based on either your existing knowledge of the literature, or on papers mentioned in Christensen's book, or on the topics mentioned below.
3. Select a paper that interests you, and bring it to the professor for help in narrowing the scope of your project, and comments and approval.
4. After the professor approves your choice, then read the paper carefully. Summarize the contents, and determine how they relate to our course.
5. Prepare your handout and your oral presentation notes. Practice your presentation.

### *Possible Topics*

You are welcome to select one of the following papers. Most papers can be found using MathSciNet. Benedetto's papers can be found at his website <http://www.math.umd.edu/~jib/recentmss.html> and Casazza's papers are at his site <http://www.math.missouri.edu/%7epete/>

Finite normalized tight frames [J. Benedetto, M. Fickus]

Custom building finite frames [P. Casazza]

The known equal norm Parseval frames as of 2005 [P. Casazza]

Existence and construction of finite tight frames [P. Casazza and M. Leon]

A generalization of Gram-Schmidt orthogonalization generating all Parseval frames  
[P. Casazza and G. Kutyniok]

The role of frame force in quantum detection [J. Benedetto and A. Kebo]

On signal construction without phase [R. Balan, P. Casazza and D. Edidin]

Frames and their application on robust signal transmission [by J. Jorgensen and M. Edwards,  
based on work of Goyal, Kovacevic and Kelner; see Laugesen for a hard copy]

Frames of subspaces [P. Casazza and G. Kutyniok]

Fusion frames and applications to sensor networks [various authors],  
see <http://www.fusionframe.org>

Ambiguity function and frame theoretic properties of periodic zero autocorrelation waveforms  
[J. Benedetto and J. Donatelli]

Sigma-delta quantization of finite frames [J. Benedetto, A. Powell, O. Yilmaz],  
several recent papers

Please ask me questions if any step of the process is unclear.

- Richard Laugesen (Laugesen@uiuc.edu)