Fall 2018
MATH 858W

Frames, Sampling, and Wavelets

Instructor: John Benedetto
Tue/ Thur, 11:00-12:15 p.m
MATH
Grading: *1/3 homework, 1/3 project, 1/3 attendance/participation/study*
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COURSE MATERIAL

1. Time-frequency (Gabor) analysis on R^d and the role of the Heisenberg group. The short time Fourier transform (STFT), narrow band ambiguity function, and applications.

2. **Wavelet theory on R^d and the role of the ax+b group**. The wide band ambiguity function and applications.

3. **Frames**. Time-frequency (Gabor) and wavelet frames, frame multiresolution analysis, Grassmannian frames, harmonic and group frames, and the role of the DFT. Applications to quantum information theory and open problems.

4. **Sampling theory**. Uniform sampling on R and R^d, Poisson summation and applications, quasi-crystals and non-uniform Poisson summation, balayage and non-uniform sampling, Sigma-Delta quantization and non-linear sampling, dynamical sampling

5. **Compressed sensing (sampling)**. Gabor and wavelet matrix equations, sparse solutions, the role of the Donoho/Stark and Tao uncertainty principles for compressed sensing, mathematical properties of Gabor matrices for CAZAC generating functions.

6. **Uncertainty principles**. The Balian-Low phenomenon and Bourgain's theorem.