

BI-CO MATHEMATICS COLLOQUIUM

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*“Diffusion Wavelet Frames and an
Application of Laplacian Eigenmaps to
Retinal Imaging”*

Monday, April 25, 2016

Talk at 4:00 – Park 338
Tea at 3:30 – Park 355, Math Lounge

Abstract:

We first present a novel tool of signal processing: Diffusion Wavelet Frames. In 2006, Coifman and Maggioni showed that many Fourier and wavelet analysis tools can be carried to the setting of digital data clouds, graphs, and manifolds. Starting with a diffusion operator T on a manifold or a graph, we construct a general multiresolution analysis using dyadic powers of T , as in traditional wavelet theory. Our Diffusion Wavelet Frames approximate the multiresolution spaces while avoiding the computationally expensive orthogonalization process in Coifman and Maggioni's construction. We also present a novel method based on Laplacian Eigenmaps, another kernel-based algorithm for automated anomaly detection on autofluorescent data provided by the National Institute of Health (NIH). This is motivated by the need for new tools to improve the capability of diagnosing macular degeneration in its early stages, track the progression over time, and test the effectiveness of new treatment methods. The method that we propose is a Vectorized Matched Filtering (VMF) algorithm combined with Laplacian Eigenmaps (LE), a nonlinear dimensionality reduction algorithm with locality preserving properties. We evaluate our performance by comparing our method to two other schemes: a matched filtering algorithm based on anomaly detection on single images and a combination of PCA and VMF. We show that LE combined with VMF algorithm performs best, yielding a high rate of accurate anomaly detection.

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