

# 数学与系统科学研究院

## 计算数学所学术报告

报告人: **Prof. Bin Dong**

( *Beijing International Center for Mathematical Research, Peking  
University* )

报告题目:

**Wavelet Frame Transforms and  
Differential Operators: Bridging  
Discrete and Continuum for Image  
Restoration and Data Analysis**

邀请人: 刘亚锋 博士 刘歆 博士

报告时间: **2015 年 1 月 9 日 (周五)**

**下午 16:00-17:00**

报告地点: **数学院南楼七层 702  
会议室**

## **Abstract:**

My talk is mainly based on a series of three papers ([1-3] below). In [1], we established connections between wavelet frame transforms and differential operators in variational framework. In [2], we established their connections for nonlinear evolution PDEs. Based on [1,2], we proposed a new piecewise smooth image restoration model based on wavelet frames in [3], and linked it with a brand new variational model, a special case of which resembles, but is superior to, the well-known Mumford-Shah model. The connections established in [1-3] provide us with new insights and inspiring interpretations of both wavelet frame and differential operator based approaches, which enable us to create new models and algorithms for image restoration that combine the merits of both approaches. The significance of our findings is beyond what it may appear. In fact, our analysis and discussions in [1-3] already indicate that wavelet frame based approach is a new and useful tool in numerical analysis to discretize and solve variational and PDE models in general, which enriches the existing theory and applications of numerical PDEs, variational techniques, wavelet frames, etc.

Although the main application considered is image restoration, I will also discuss possible extensions to high-dimensional unstructured data analysis [4]. I will present a unified theory of tight wavelet frames on non-flat domains in both continuum setting, i.e. on manifolds, and discrete setting, i.e. on graphs; discuss how fast tight wavelet frame transforms can be computed and how they can be effectively used to process and analyze graph data.

[1]. J. Cai, B. Dong, S. Osher and Z. Shen, Image restoration: total variation; wavelet frames; and beyond, Journal of AMS, 25(4), 1033-1089, 2012.

[2]. B. Dong, Q. Jiang and Z. Shen, Image restoration: wavelet frame shrinkage, nonlinear evolution PDEs, and beyond, preprint, December 2013.

[3]. Jian-Feng Cai, Bin Dong and Zuowei Shen, Image restorations: a wavelet frame based model for piecewise smooth functions and beyond, preprint, April 2014.

[4]. Bin Dong, Sparse Representation on Graphs by Tight Wavelet Frames and Applications, preprint, November, 2014.

# 欢迎大家参加！