Advances in Adaptive Data Analysis
Vol. 3, Nos. 1 & 2 (2011) v–vi

DOI: 10.1142/S1793536911000672

World Scientific
www.worldscientific.com

INTRODUCTION

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This special issue of *AADA* is devoted to the research topics presented in the highly stimulating international workshop on "Sparse Representation of Multiscale Data and Images: Theory and Applications", which was held in the Institute for Advanced Studies at the Nanyang Technological University (NTU) at Singapore from December 14 to 17, 2009. This workshop was coorganized by Thomas Hou (Caltech, USA) and Xue-Cheng Tai (NTU, Singapore).

The generous support from the Institute of Advanced Studies (IAS), School of Physical and Mathematical Sciences (SPMS) and NTU is greatly appreciated.

In recent years, there has been an explosive growth in developing new efficient algorithms to represent multiscale signals and images by exploiting the sparsity of these signals or images. The compressed sensing or compressive sampling has been a great success and opens up a new research area. In imaging analysis, the total variation norm has been widely used to represent sharp edges and high contrast of images. This provides a L^1-based norm instead of the traditional Fourier-based L^2 norm, which is essential in producing a sparse representation of images.

In the area of multiscale modeling and computation, multiscale basis has been constructed to represent the multiscale solution with a small number of problem-dependent bases on the coarse grid, resulting in a sparse representation of the multiscale solution in a relatively coarse grid.

In parallel to the development of multiscale methods and compressed sensing, various adaptive data analysis methods have been developed in the past two decades to analyze nonlinear, nonstationary data. One of the objectives of these methods is to reveal some hidden physical features from these data. The empirical mode decomposition (EMD) method has received a lot of attention in recent years. It can typically decompose a complicated multiscale signal into a small number of intrinsic

mode functions (IMFs). In some sense, it can be considered as a nonlinear version of sparse time-frequency representation of data although its mathematical analysis is far more difficult.

This workshop brought many leading experts from these areas together to exchange ideas, reported the latest developments in these areas, and identified new research opportunities. The workshop turned out to be a great success. The workshop participants typically did not attend the same conference. The IAS workshop provided a platform for these experts to interact with one another. Many participants found the discussions and exchanges extremely useful and stimulating. Based on the success of this workshop, a Hot Topic Workshop will be held at the Institute of Mathematics and Its Applications (IMA) from September 7 to 9, 2011 to further investigate trend and instantaneous frequency for multiscale data, and their applications to various disciplines.

The papers published in this special issue are research papers and survey articles from some of the invited speakers of the IAS/NTU workshop. A complete list of the speakers as well as more detailed description of the workshop can be found from the conference Web site: http://www.ntu.edu.sg/ias/upcomingevents/srmdi09/pages/default.aspx.

We roughly divide the papers into four groups: (1) adaptive data analysis; (2) sparse representation of data; (3) sparse representation of images; and (4) multiscale and multiresolution analysis. The quality of the papers is consistent with that of the workshop. We believe that they provide a timely and useful review for these four interrelated research areas.