Title:
Multi-Modal Data Processing: An Approach via Sparsity

Abstract:
Making sense of modern datasets, in which data is often multi-modal and heterogeneous, is a challenging task that is becoming increasingly important for both academia and industry. In this work, we look at sparsity-based approaches to process multi-modal and heterogeneous data. We start with the problem of integrating prior knowledge into sparse reconstruction schemes. Prior information here means a signal similar to the signal to be reconstructed, for example, in medical imaging, a prior scan of the same patient. Our theory provides a minimal number of measurements required to reconstruct the original signal as a function of the quality of the prior information. We then describe an approach to separate the x-rays of the paintings in the door panels of the Ghent Altarpiece, a 15th century art work by Van Eyck which was recently restored. Our method uses the visual images to aid the separation process and outperforms prior state-of-the-art methods, such as morphological component analysis. Finally, we state preliminary theoretical results on a framework that allows processing arbitrary, but correlated, heterogeneous data such as images and sound, or text and location.

Bio:

Joao F. C. Mota received the M.Sc. degree and the Ph.D. degree in Electrical and Computer Engineering from the Technical University of Lisbon, Portugal, in 2008 and 2013, respectively. He also received the Ph.D. degree in Electrical and Computer Engineering from Carnegie Mellon University, US, in 2013. From 2013 to 2016, he was Senior Research Associate at University College London, London, UK. In 2017, he became Assistant Professor in the School of Engineering and Physical Sciences at Heriot-Watt University, Edinburgh, UK., where he is also affiliated with the Institute of Sensors, Signals, and Systems. His current research interests include theoretical and practical aspects of high-dimensional data processing, multi-modal processing, inverse problems, optimization theory, machine learning, data science, and distributed information processing and control. He was the recipient of the 2015 IEEE Signal Processing Society Young Author Best Paper Award for the paper "Distributed Basis Pursuit", published in IEEE Transactions on Signal Processing.