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Plenary Lecture

ENHANCING SPARSITY BEYOND CONVEXITY: APPLICATIONS TO THE RESTORATION AND SEGMENTATION OF MEDICAL IMAGES AND SURFACES

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Summary: This talk concerns the design and numerical solution of variational models for image processing. In particular we present models containing non-convex non-smooth regularization terms involving a sparsity-inducing prior which improves the solution quality.
These models arise in a wide variety of research areas, and we are interested in their application to the restoration of images corrupted by blur and noise, and the segmentation of images as well as surfaces, i.e. the partitioning of the data into regions that are homogeneous according to a certain feature.
We first introduce the Convex-NonConvex strategy which relies on the idea of constructing and then optimizing convex functionals containing non-convex (sparsity-promoting) regularization terms. This allows for using reliable convex minimization approaches to compute the (unique) solution.
We then deal with the pure non-convex regime by briefly presenting a new space-variant regularization which holds the potential for better modeling space variant properties of real images.
We discuss how to solve numerically these models and highlight their effectiveness in practical applications such as image restoration and segmentation.
Based on joint works with Raymond Chan, Martin Huska, Alessandro Lanza, Serena Morigi, Lothar Reichel, Ivan Selesnick.