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# Mathematics and Visual Analysis

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This special issue of JMIV is focussed on recent developments in the fields of mathematical image analysis. The emphasis of this issue is the interplay between advanced mathematical methods (such as partial differential equations, convex optimization, sparsity) and the application of these methods in image processing, computer vision and computer graphics. It is the result of a call for papers sent to all selected speakers of the seventh conference on Mathematics and Image Analysis (MIA'09), which took place in Paris on December 14–16, 2009. This special issue is not a proceeding of the MIA'09 conference, and is composed of original contributions. The papers in this issue underwent a rigorous review process reflecting the highly selective standards of JMIV.

A first series of papers composing this special issue is concerned with the development of new mathematical methods for image processing. This includes fast non-smooth convex optimization algorithms that can handle efficiently recent image priors used for image restoration. The paper "*Proximal Algorithms for Multicomponent Image Recovery Problems*" of Combettes et al. proposes a generic convex optimization framework to tackle various color image processing. A related non-smooth optimization approach is used by Jezierska et al. "*A spatial regularization approach for vector quantization*" to reconstruct images from quantized values. Sparsity in redundant dictionaries has become a popular image prior that corresponds to non-smooth convex functionals. Woiselle et al. extend several 2-D sparse representations to the 3-D setting in their paper "*3D Data Denoising and Inpainting with the Fast Curvelet transform*" (previously published in Volume 39, Number 2, 121–139, under DOI 10.1007/s10851-010-0231-5). In "*Sparsity Driven People Localization with a Heterogeneous Network of Cameras*" Alahi et al. show an application of these sparse optimization schemes to a difficult computer vision problem, where sparsity is crucial to obtain an efficient detection.

Partial differential equation and variational methods are at the heart of several mathematical successes in image processing, in particular for the restoration of noisy damaged images. The paper "*Can Variational Models for Correspondence Problems Benefit from Upwind Discretisations?*" of Michael Breuß et al. (previously published in Volume 39, Number 3, 230–244, under DOI 10.1007/s10851-010-0237-z) is concerned with the numerical foundation of the resolution of these PDE's in the case of optical flow and stereo vision. Batard introduces in "*Heat Equations on Vector Bundles—Application to Color Image Regularization*" a framework for PDE's with vector valued images. The paper "*Hypercomplex mathematical morphology*" of Jesus Angulo et al. is also concerned with images taking values in higher dimensions, from the perspective of mathematical morphology.

The mathematical modeling of images is important to improve the processing of natural images. Mirebeau and Cohen perform in "*Anisotropic Smoothness Classes: From Finite Element Approximation to Image Models*" (previously published in Volume 38, Number 1, 52–69, under DOI 10.1007/s10851-010-0210-x) a detailed analysis of the cartoon image model of geometric images, and propose a

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variational energy to capture the curvature of the level sets. The paper "*Virtual Super Resolution of Scale Invariant Textured Images Using Multifractal Stochastic Processes*" of Chainais et al. (previously published in Volume 39, Number 1, 28–44, under DOI 10.1007/s10851-010-0222-6) exposes a stochastic texture model based on a multifractal cascade that can be used to perform a statistical extrapolation of the texture resolution.

Applications in computer vision and graphics can gain a major benefit from a deep mathematical analysis and understanding. In "*Fattening Free Block Matching*", Blanchet et al. study the theoretical limits of stereo vision and propose a scheme to achieve a high precision depth estimation. The paper "*Recursive Compositional Models for Vision: Description and Review of Recent Work*" of Yuille et al. reviews several statistical models for computer vision in a unifying framework. The work "*Transportation Distances on the Circle*" of Rabin et al. studies several distances derived from the theory of optimal transportation that can be used to perform shape retrieval.

Guest editors