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Guest Editorial JMIV Special Issue Mathematics and Image Analysis (MIA)

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This special issue highlights recent developments in the field of mathematical image analysis. The emphasis of the issue is on the interplay between advanced mathematical methods advanced mathematical methods (such as non-smooth optimization, variational methods, statistics, geometry, inverse problems, partial differential equations) and their application to a variety of problems in image processing and computer vision.

This special issue consists of four papers which cover the following topics:

- *Curve Fitting to Points on Manifolds* The fitting of parameter-dependent data on a Riemannian manifold is a problem arising in various applications. Prominent examples are computational anatomy, where denoising and resampling the evolution of the shape of an organ leads to a curve fitting problem on a shape manifold or in robotics and computer graphics, where motion planning of rigid 3D bodies requires interpolation or approximation on the special orthogonal group. In *"Data fitting on manifolds with composite Bezier-like curves and blended cubic splines"* (DOI JMIV-D-17-xxxx), P.-Y. Gousenbourger, E. Massart and P.-A. Absil address several methods for fitting a C^1 curve to time-labeled data points on a Riemannian manifold and demonstrate their performance on synthetic and real-world data.
- *Biconvex Non-Smooth Optimization Methods for Image Colorization* Inspired by the challenging problem of image colorization, P. Tan, F. Pierre and M. Nikolova propose in their paper *"Inertial Alternating Generalized Forward-Backward Splitting for Image Colorization"* (DOI JMIV-D-17-xxxx) a new accelerated alternating optimization scheme to solve block-biconvex non-smooth problems whose objectives can be split into smooth regularizers and simple coupling terms. Their method is actually a Bregman distance-based generalization of the forward–backward splitting for each block, along with an inertial strategy for empirical acceleration. For large classes of non-convex non-smooth functions, the convergence behavior is analyzed including the parameter choice.
- *Diffeomorphic Deformation for Solving Inverse Problems* In *"Incorporation of a deformation prior in image reconstruction"* (DOI JMIV-D-17-xxxx), B. Gris presents a method to incorporate a deformation prior in image reconstruction via the formalism of deformation modules. This formalism allows to build diffeomorphic deformations that satisfy a given structure and encompasses many previous approaches in this direction. For instance, in the case of biological images, this framework would ensure that only the deformations that are

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possible from a biological point of view are considered. She demonstrates the basic idea to register a template image against the indirectly observed data by 2D simulations of two different natures: tomographic data and partial observation.

- *Anomaly Detection* In their review paper *"Image anomalies: a review and synthesis of detection methods"* (DOI JMIV-D-17-xxxx), T. Ehret, A. Davy, J.-M. Morel and M. Delbracio consider a broad variety of methods that have been proposed for anomaly detection in images and search for an arguably general anomaly detection framework emerging from their analysis. A challenge of the topic is that there does not exist a canonical definition of what is (ab)normal for a given image of great interest. Yet, all anomaly detection methods make a general structural assumption on the normal background that actually characterizes the method. By combining such assumptions with a generic statistical detection tool, the authors end up by proposing several generic algorithms that generalize or reconcile most methods. To evaluate their conclusions, they compare representatives of the main algorithmic classes on classic and diversified examples.