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In the area of Medical Imaging Processing, a real interplay between physicians, engineers, computer scientists and mathematicians has been occurring over the last decade. Applied Mathematics play a decisive role in the derivation and construction of efficient and robust algorithms. Contributions come from almost any discipline of mathematics, but mainly from optimization theory, partial differential equations, variational modelling and analysis.

Anatomical structures and biological functions can be studied through a variety of medical imaging modalities which can produce a considerable amount of images. However, accurate assessment of a given physiological or pathological aspect may require the development of a specific image-processing program, which is also to speed up the analysis and guaranty the user independency of the results. Effective practical usage of such programs relies both on the assessment of the theoretical properties of algorithms and a thorough evaluation. The underlying theory is critical as it determines the properties, the behaviour and the limits of the developed methods. There exist numerous theoretical frameworks and this topical issue considers some of them.

Six papers have been selected to illustrate efforts on mathematical developments in the field of medical image processing and analysis. First, Benson et al. undertook the reconstruction of canine cardiac architecture in regions of the left and right ventricular free walls and in the inter-ventricular septum from Diffusion Tensor Imaging. Accurate description of the anatomy is a fundamental prerequisite for developing realistic numerical models.

Still in the cardiac imaging context, Barnes et al. introduce a variational framework for the assessment of the left ventricle motion from Tagged Magnetic Resonance Imaging. The approach is based on tracking the phase of the response to a Gabor filter bank. It is exploited for the extraction of normality models for the heart motion from a set of 19 healthy subjects.

De Craene et al. propose an approach for the alignment of a large collection of segmented images and the estimation of a common reference coordinate system. Various properties of the method are illustrated on a large collection of brain images. The proposed approach can be used for the unbiased construction and analysis of anatomical atlases, which is of central importance when comparison with a mean model is addressed.

Two papers deal with fractal analysis. Akkari et al. investigate the relationship between 2D and 3D fractal dimensions computed respectively from slices and volumes. The concepts are illustrated on synthetic models and CT bone images. The second work by Lopes et al. proposes multidimensional models to evaluate multifractal analysis methods.

Finally, the last paper of this issue is devoted to some qualitative properties of evolution partial differential equations which are used in image processing.

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The Topical Issue Editors
P. Clarysse, D. Metaxas, J. Pousin

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