Editorial **Open Access**

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Editorial — Special Issue: ISMM 2019

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Abstract: This editorial presents the Special Issue dedicated to the conference ISMM 2019 and summarizes the articles published in this Special Issue.

Keywords: Mathematical morphology, ISMM

1 Introduction

This special issue is dedicated to research work presented in the 14th International Symposium on Mathematical Morphology (ISMM 2019), held in Saarbrücken, Germany, during July 8–10, 2019. In this conference, there were 41 accepted papers (including 40 regular papers, plus one related to an invited plenary talk) from 11 different countries: Austria, Brazil, France, Germany, Greece, India, Italy, The Netherlands, Sweden, UK, and USA. These 41 articles were published in an LNCS volume [5].

Authors were then invited to submit extended versions of their articles in the current Special Issue. All the manuscripts submitted in this context underwent a new review process. Finally, five articles were accepted for publication in this special issue. They are summarized hereafter.

2 Articles published in the Special Issue

In [1], T. Asplund et al. extend their previous works, published in ISMM 2019 [3] as well as in [2]. This article deals with the almost ubiquitous problem of approximating continuous morphology by discrete morphology. This refers to the output signal, the input signal as well as the morphological operators. The proposed approximation relies on a specific irregular sampling technique of both the output and input signals, hence capturing the important extrema in the input. Additionally irregular sampling along the boundary of structuring elements allows the use of non-flat and adaptive structuring elements. Experiments with dilation operators confirm the superiority of this irregular sampling approach over the regular discrete sampling. Future work could aim at improvement of the sampling strategies applied to the input signal as well as the structuring element and the experimental comparison of the proposed approach with PDE-based methods.

In [8], H. ElNaghy and L. Dorst propose an extension of their previous work published in ISMM 2019 [9]. Their article considers the fitting of archaeological fragments by employing hierarchically the scale-space of mathematical morphology. They investigate the effect of masking for morphological operations when applied to certain subsets of objects. Their approach uses boundary morphology instead of volumetric information. Specifically, they focus on the closing and opening operations and show the Lipschitz nature of terracotta fractures. Additionally, their new approach is justified due to the fact that the effects of abrasion and un-

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certainty are naturally bounded. Future work might go in the direction of using a provenance map of the distance transform in order to control the reliability of their representations specifically for missing parts of the original fracture facet.

In [4], S. Blusseau et al. propose an extension of their previous work published in ISMM 2019 [13]. They construct a part-based representation of a data-set of images by looking at a non-negative sparse decomposition of the images on a reduced set of atoms. This leads to an understanding of the structure within the given data. Any new sample different from the previous data shall be similarly decomposed by an online computation. To achieve this goal, their sparse and non-negative auto-encoder is deep for accuracy and shallow for explainability. The authors show their new method compares well with respect to the state-of-the-art online methods for both two benchmark data-sets (MNIST and Fashion MNIST) and a hyperspectral image with respect to classical evaluation measures and a new one that has been introduced. A potential improvement of their proposed method could be achieved by imposing a major sparsity to the dictionary data. The use of the (max, +) algebra could be a direction of future research.

In [6], K. Chang and B. Figliuzzi propose an extension of their previous work published in ISMM 2019 [7]. Superpixel image decompositions aim at providing compact and faithful image representations that can be used by higher level image analysis methods. Here, a novel algorithm is proposed for image superpixel generation based on the fast marching method called *Fast Marching Superpixels* (FMS). The novelty of this algorithm resides in the incorporation of texture information in the velocity function of the Eikonal equation governing the expansion of the superpixels. The authors propose and study different strategies to measure and inject this texture information into the propagation algorithm. The method is validated on a texture dataset where it outperforms classic superpixel methods. Finally, the FMS algorithm is assessed on a standard image dataset where it obtains performances comparable or better than state-of-the-art superpixel algorithms. Possible future work directions include the introduction of explicit image gradient information in the velocity function or the automatic estimation of optimal method parameters.

In [10], M. Jouni et al. propose an extension of their previous works published in ISMM 2019 [11] and in IGARSS 2019 [12], respectively. This article deals with the problem of dimensionality reduction of hyperspectral images where the features associated to each pixel are heterogeneous. This case is common in remote sensing where morphological attributes such as morphological profiles or attribute profiles are used to enrich spectral information with spatial information leading to a multimodal structure of the features. The authors propose a new method for dimensionality reduction called *Canonical Polyadic Decomposition* that aims at preserving the multimodality of the feature space. The efficiency of the proposed method is demonstrated on several remote sensing datasets with several different morphological attributes showing promising results on the pixel classification task.

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