Preface

Since the early 20th century, medical imaging has been dominated by monochrome imaging modalities such as x-ray, computed tomography, ultrasound, and magnetic resonance imaging. As a result, color information has been overlooked in medical image analysis applications. Recently, various medical imaging modalities that involve color information have been introduced. These include cervicography, dermoscopy, fundus photography, gastrointestinal endoscopy, microscopy, and wound photography. However, in comparison to monochrome images, the analysis of color medical images is a relatively unexplored area. The multivariate nature of color image data presents new challenges for researchers and practitioners as conventional methods developed for monochrome images are often not directly applicable to multichannel images.

The goal of this volume is to summarize the state-of-the-art in the utilization of color information in medical image analysis and provide future directions for this exciting subfield of medical image analysis. The intended audience includes researchers and practicing clinicians, who are increasingly using digital analytic tools.

The volume opens with "A Data Driven Approach to Cervigram Image Analysis and Classification" by Kim and Huang. The authors describe an automated, data centric system for cervigram image analysis that utilizes color and texture features extracted from the regions of interest to classify unseen cases using a Support Vector Machine classifier trained on several thousand annotated images. The authors report a sensitivity of 75 % and a specificity of 76 % on a set of 2,000 images.

The volume continues with four chapters on skin lesion image analysis. In "Macroscopic Pigmented Skin Lesion Segmentation and Its Influence on Lesion Classification and Diagnosis," Cavalcanti and Scharcanski investigate the influence of segmentation accuracy on skin lesion classification. The images are first enhanced using a novel shading attenuation algorithm. Following a segmentation step, various shape, color, and texture related features are then extracted from the lesions. Finally, the images are classified using a 1-Nearest Neighbor (1-NN) classifier. The authors compare six recent monochromatic and multichannel segmentation meth-

ods and conclude that the use of color information during segmentation improves the accuracy of classification.

In "Color and Spatial Features Integrated Normalized Distance for Density Based Border Detection in Dermoscopy Images," Kockara *et al.* propose an improved density based clustering algorithm for detecting lesion borders in dermoscopy images. This algorithm is an accelerated version of the celebrated DBSCAN (Density Based Spatial Clustering of Applications with Noise) algorithm and it does not require any preprocessing. The authors obtain promising results on a difficult set of 100 dermoscopy images.

In "A Color and Texture Based Hierarchical K-NN Approach to the Classification of Non-Melanoma Skin Lesions," Ballerini *et al.* describe a hierarchical classification system for non-melanoma skin lesions based on the K-NN classifier. The images are first segmented using a region-based active contour model. Color and texture related features are then extracted from the lesions. Finally, the images are classified using a hierarchical K-NN classifier. The authors obtain promising results on a set of 960 macroscopic images that contains five classes of non-melanoma skin lesions.

The final skin lesion analysis chapter, "Color Quantization of Dermoscopy Images Using the K-Means Clustering Algorithm" by Celebi *et al.*, investigates the applicability of a recently proposed k-means based color quantization method to dermoscopy images of skin lesions. This method improves upon conventional k-means based color quantization by using data reduction, sample weighting, accelerated nearest neighbor search, and deterministic cluster center initialization. The authors demonstrate that their method outperforms state-of-the-art quantization methods with respect to distortion minimization.

In "Grading the Severity of Diabetic Macular Edema Cases Based on Color Eye Fundus Images," Welfer *et al.* present an automated method for detecting and grading diabetic macular edema signs in color eye fundus images. First, the optic disc, fovea center, and exudates are detected using a sequence of morphological operators. The spatial distribution of the exudates around the macula center is then used to classify each case into one of four categories (absent, mild, moderate, and severe) using a CART (Classification and Regression Trees) classifier. The authors obtain an average accuracy of over 94 % on a set of 89 publicly available images.

In "Colour Image Analysis of Wireless Capsule Endoscopy Video: A Review," Fisher and Mackiewicz present a comprehensive survey of wireless capsule endoscopy video analysis focusing on the related color imaging aspects. After presenting an overview of the history of the field, the authors discuss feature extraction, segmentation, significant event detection, and adaptive control of viewing speed.

The volume continues with two chapters on microscopy. In "Automated Prototype Generation for Multi-Color Karyotyping," Wu *et al.* present a three-step method for generating a prototype from multicolor karyotypes obtained via multispectral imaging of human chromosomes. The first step involves the automated extraction of individual chromosomes from each karyotype, followed by chromosome straightening and size normalization. In the second step, the extracted and normalized chromosomes belonging to each of the 24 color classes are automatically assigned to a particular group based on the ploidy level. Finally in the third

step, the prototype of the color karyotype is determined by generating a representative chromosome for each group using pixel-based fusion.

Bueno *et al.* in "Colour Model Analysis for Histopathology Image Processing" compare five color models, namely Red-Green-Blue (RGB), Hue-Saturation-Intensity (HSI), Cyan-Magenta-Yellow-Black (CMYK), CIELAB, and Hue-Saturation-Density (HSD), for the analysis of histological whole slide images. Based on visual examination and Receiver Operating Characteristic (ROC) curve analysis the authors conclude that the CIELAB model gives the best results.

A chapter on burn image analysis entitled "A Review on CAD Tools for Burn Diagnosis" by Sáez *et al.* completes the volume. The authors discuss the issue of color normalization and then present a comparison of several color segmentation methods applied to burn images. The chapter concludes with a discussion of color based estimation of burn depth using a Fuzzy-ARTMAP classifier.

As editors, we hope that this volume focused on analysis of color medical images will demonstrate the significant progress that has occurred in this field in recent years. We also hope that the developments reported in this volume will motivate further research in this exciting field.

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