Preface

Medical diagnostics has been supported by image analysis and processing for many years. Nowadays it is very difficult to imagine image diagnostics without the use of image analysis and processing tools. All types of devices such as optical tomography, ultrasound or X-ray equipment often have advanced possibilities of image manipulation and processing. These operations, performed directly in images, facilitate decision-making. These are mostly features of the images (both 2D and 3D) themselves. For example, the number and parameters of objects in the image or their distribution relative to the adopted coordinate system are analysed. This enables to calculate the progress of retinal detachment treatment, the degree of spinal curvature and the degree of colour reaction of cells in microscopic imaging, or diagnose Hashimoto's disease in ultrasound imaging. The methods for tracking the movements of individual objects or subsequent analysis of their trajectories are found equally often. For example, there is tracking of sperm trajectories necessary for the assessment of its mobility, tracking of insects needed to assess their behaviour or analysis of cell proliferation in microscopic imaging. In each of these cases the base are image analysis and processing methods profiled for a particular application. The need to profile them results from the nature of biological and medical images and, above all, high inter-individual variability of patients. On the other hand, the proposed methods should be versatile enough to work well in different medical centres for different types of patient populations. Maintaining the right balance between these two elements is generally implemented through an appropriate algorithm structure. The algorithm sensitivity to changes in parameters (e.g. the position of the patient relative to the imaging device) and algorithm features, such as fully automatic measurement and repeatability of the results, are important here as well. One such type of devices requiring a profiled algorithm for image analysis and processing is the Corvis® ST, OCULUS Optikgeräte GmbH, Germany (hereinafter abbreviated to Corvis). In this tonometer, using the proposed algorithm, it will be possible to measure parameters related to corneal deformation or the eyeball reaction over time.

This book is therefore suitable for both researchers who want to expand their knowledge on the use of image analysis and processing methods in the Corvis tonometer and students of computer science and bioengineering. The presented algorithms were implemented in MATLAB© (hereinafter abbreviated to Matlab) and tested in practice. Therefore, this book is also addressed to doctors, particularly ophthalmologists who by using the described methods can gain new and diagnostically important features of the cornea and eyeball. However, due to the considerable complexity of algorithms, a basic knowledge of Matlab is required from the reader.

The described algorithms have been presented in this monograph in the form of Matlab source code. The choice of Matlab results from its versatility in various fields of science. Owing to numerous toolboxes, it can be applied not only in image analysis and processing but also in economics, electronics or statistics. An extension of these known toolboxes is a group of algorithms presented in this monograph. They are also available in the form of m-files attached to this book. It should be emphasized here that the presented algorithms are only one of the possible solutions to a given problem and do not exhaust this very interesting subject.

The presented algorithms may also be used to solve other problems occurring in automatic biomedical image analysis. Some selected as well as all of the presented algorithms may also be applied, for example, in the analysis of X-ray and thermal images as well as images from CT where full automation and repeatable results are essential.

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