Computational and Mathematical Methods in Medicine

Special Issue on
Retinal Image Analysis

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There is a general need for automatic systems to detect and deal in a cheaper and more efficient way with the diseases related to the retina. The cause is clear: on one hand, the increasing of the mean population age is accompanied with a growth in the number of diseases related to aging, macular degeneration, for instance. On the other hand, the generalized sedentary life is responsible for the growth of several diseases such as diabetes that, if uncontrolled, can lead to blindness due to diabetic retinopathy.

Mass screening programs focused on detecting ocular disorders are effective if the disease is treatable and can be identified on an early stage. These programs usually consist of the acquisition of color images of the retina in a noninvasive way, such as 2D fundus images and 3D optical coherence tomography (OCT) images, and their subsequent study by a medical expert. Due to the large number of patients going through them, the added work represents an overload for the medical expert that must manually analyse every single image. The automation of the process would have positive effects for both patient and medical expert and therefore Computer Aided Diagnosis (CAD) tools would be highly appreciated. In particular, CAD systems are applicable in the automatic classification and grading of several retinal diseases including glaucoma, macular degeneration, diabetic retinopathy, cataract, and pathologic myopia. These CAD systems are based on the identification of the symptoms and pathologies manifestations within the images, including the assessment of retinal vasculature, identification of retinal lesions such as microaneurysms and bleeding, assessment of optic nerve head (ONH) morphology and shape, segmentation and analysis of retinal layers, and 2D/3D detection of symptomatic exudate-associated derangements.

Common CAD systems are composed of various stages: image preprocessing, feature extraction, and automatic classification and grading. For this final stage, techniques such as Support Vector Machine (SVM), Radial Basis Function (RBF) Network, and Neural Network (NN) are most commonly used.

At the view of the state of the art, there have been increasing efforts of the scientific community to develop techniques devoted to retinal images analysis. However, there is still a potential for reducing costs and processing time while increasing effectiveness. The possibility of reaching remote locations where the lack of specialist is unavoidable should be also considered.

This special issue aims at providing the most recent developments in the field of retinal image analysis algorithms. The topics of this issue are oriented towards the use of image processing techniques.

Potential topics include but are not limited to the following:

- Retinal image preprocessing: enhancement, registration, and normalization
- Automated localisation and segmentation of retinal structures and landmarks: optic disc, fovea, macula, and vascular tree
- Detection of retinal abnormalities such as microaneurysms, haemorrhages, exudates, cotton wool spots, and macular oedema
- Quantitative measurements and features extraction from retinal images: vessels' width and tortuosity, arteriovenous ratio, cup to disc ratio, and so on
- Retinal OCT images analysis
- Computer Aided Diagnosis tools devoted to the diagnosis and grading of retinal diseases: diabetic retinopathy, glaucoma, macular degeneration, and so on
- Application of retinal image analysis in telemedicine
- Clinical perspectives and experiences

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