Politechnika Śląska
Wydział Inżynierii Biomedycznej

Algorytmy komputerowej analizy obrazów w analizie deformacji rogówki oka

Rozprawa doktorska w dyscyplinie inżynieria biomedyczna
w formie zbioru powiązanych tematycznie artykułów naukowych

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SUMMARY OF DOCTORAL DISSERTATION

Computer image analysis algorithms in the analysis of corneal deformation

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Currently, image analysis and processing is a dynamically developing interdisciplinary field. Thanks to the quantitative assessment of processed images, it is possible to distinguish the characteristic properties and features of the objects contained in the images. The development of modern technologies in the field of imaging diagnostics of the eye, as well as the literature review performed and knowledge obtained in cooperation with ophthalmologists, indicate an increasing need for constant improvement of the existing methods and search for new solutions in the field of analysis and processing of images of the sight organ.

The doctoral dissertation is a series of seven thematically related scientific publications. The studies presented in these papers concern the use of computer image analysis algorithms for the analysis of corneal deformation as well as the assessment of biomechanical parameters of the cornea in supporting the process of ophthalmic diagnostics. As part of the doctoral dissertation, a method for automatic determination of the outer corneal edge allowing for the detection of its full contour has been developed. The proposed method is resistant to disturbances characteristic for image acquisition, and also proved to be the most effective (ensuring the most accurate detection of the outer corneal edge) of all the edge detection algorithms tested. In subsequent papers of the publication cycle, a detailed analysis of the diagnostic usefulness of the available parameters of dynamic corneal deformation was performed, presenting the relationship between the characteristic parameters and lesions of the cornea. Then, a method of analysing the corneal structure, which enables to track characteristic changes in its structure, and two new parameters of dynamic corneal deformation have been developed. Tests were also carried out to verify the correctness of the patient's positioning during tonometry examinations.

The studies performed as part of the doctoral dissertation extend the range of available methods of computer image analysis. Moreover, they allow for the measurement of new corneal parameters. At the same time, they expand the knowledge on the use of corneal biomechanical parameters in terms of their application in the correction of intraocular pressure, evaluation and prediction of the results of eye surgery, in particular in patients with keratoconus, and refractive surgery.