SUMMARY

„Image analysis for multiparametric characterization of cells in microfluidic systems"

The study of the physiological state or vital potential of a cell is a fundamental procedure in modern medical diagnosis and life sciences. This examination may involve microscopic observation of the cell and analysis of its image. The most frequently determined parameters of cells are their number, shape, dimensions, morphology, deformation and mobility under the influence of various factors. With the development of microscopic and IT techniques, image analysis with the "human eye" was replaced by an optoelectronic system (camera) and image processing with the use of specialized algorithms. In such a system, compared to the "human eye" analysis performed by a human by direct observation, higher throughput, automation and, above all, multi-parameter, objective analysis of the cell image is possible. Combined with microfluidic techniques that allow cells to be "managed" in very small volumes and measured in stationary or flow-through modes, image analysis becomes a new tool for multi-parameter cell analysis. This analysis is a type of advanced signal processing (in this case an image) obtained with the use of an optoelectronic system (camera). This analysis is multi-stage and carried out automatically with the use of dedicated algorithms. Therefore, the issues discussed in the dissertation fall within the disciplines of automatics, electronics and electrical engineering.

Achieving the aim of the dissertation required both literature, theoretical and experimental research. These studies required knowledge and skills in the field of the necessary mathematical apparatus related to the algorithms used, as well as programming tools for the implementation of these algorithms. Knowledge of the design and technology of microfluidic systems and optoelectronic image recording was also necessary. The resulting software is a flexible research tool that the user can adapt to the needs of the analysis of images obtained from two different microscopic systems - "traditional" and lens-free in lab-chips of various designs. This tool is constantly being developed and successfully used in subsequent research works carried out at the Department of Microsystems.

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