

Computer systems of histology image analysis in Belarus

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Abstract

The most interesting Belarussian medical systems which deal with histological images to carry out an analysis of histological and cell structures of different tissues are presented here. In this paper basic properties of system "Bioscan-IW", "AutoScan", "Contour" and "Cytron" are described. These systems are the most interesting among Belarussian histological image applications.

Key words: histology, automated system, morphometry, image processing.

Introduction

Medical morphology is the most reliable method in the diagnostic process. It is realized in the form of the biopsy, cytological and histological investigation where histological and cell structures of different tissues of the human body are the prime object of analysis. In particular, this method is vital in diagnosing various human diseases.

Computer application improves arithmetic precision for investigation in morphology. Automated systems exclude mistake of human factor and decrease expended time for process of verification diagnosis. There are not enough specialists, who can execute correct morphology analysis yet. What is more they are amassed only in big medical centers. At the same time clinicians are trying to identify complex forms of disease and reduces to mistaken diagnostics. Therefore there are a lot of cases, when incorrect untimely treatment results to disablement or death.

Therefore the task of automation for morphology diagnostics is very important in medicine. The computer system for morphological diagnostics improves accuracy of diagnostics and compensates deficit of morphologist-specialists.

The objective analysis of cytological and histological images has been the subject of research for many years. Most difficult fields in histological image analysis are automated extraction and classification of cells and analysis tissue. However, due to a complex nature of histological images, it is difficult to select or develop automatic segmentation methods that can be applied for any type of these images. Therefore the system for automation morphology investigation in histology include complex unique algorithms and techniques.

There are some international global developers of automated system: Leica Microsystems (www.leica-microsystems.com), Applied Imaging (www.aicorp.com), Hamilton Thorne (www.hamiltonthorne.com), Laboratory Imaging (www.luciacytogenetics.com), IMSTAR (www.imstar.fr), Media Cybernetics (www.mediacy.com), etc. These companies introduce one or more computer complexes for using in histological investigation [1,2]. The main goal of development in such direction is universal computer system for morphometry.

There are some automated computer system developed in Republic of Belarus. The "Bioscan-IW", "AutoScan", "Contour", "Cytron" are most interesting.

Systems of histology image analysis

"AutoScan"

(<http://www.bsuproduct.by/index.php/.20.212...0.0.0.html>)

This system is developed in Belarussian State University. The main application of this system is metallography. But "AutoScan" consist of visual and threshold allocation of objects in a picture, qualifying editing of objects, splitting of objects into arbitrarily adjusted classes, 40 measured characteristics of objects, arbitrarily formed reports (tables, histograms). The systems have specialized part of calculation of statistical infor-

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Figure 1. Screenshots of “Contour” for measurement of separate cell



Figure 2. Screenshots of “Contour” for measurement of conglomerate of cells



mation over the all characteristics, report generation (tables, histograms). This features permit to solve some task of histology. For example geometric cells measurement, cells counting.

“Bioscan-IW”

(<http://itlab.anitex.by/bioscan/>)

This system was developed in Belarussian State Medical University. This is a universal computer system with powerful software for image processing and measuring. The build-in script-interpretator allows to create macros for various investigation and diagnostic medical task [1].

This system is successfully used for diagnostic in clinical oncology and pathology anatomy, for analysis of cells evolution, for investigation to influence of new pharmacology medication, for fixation to control points in neurosurgery [4]. Unlike any other image analysis software, “Bioscan-IW” incorporates graphic editing tools and functions that work with a wide variety of image types including 16-bit, 32-bit and 64-bit (complex) images. In this connection this system promises to quality densitometry measurements. A multiple window interface allows for simultaneous display of static and live images, charts, and measurements for the rapid creation of custom applications and development of new imaging techniques. Automatic and interactive measurement functions support more than 100 built-in and user-defined geometrical, optical and topological parameters. A number of proprietary processing algorithms and interface innovations make “Bioscan-IW” one of a kind.

“Contour”

(http://uiip.bas-net.by/eng/l_ipr_projects_3.html)

This system is an expert system for thyroid carcinoma diagnosis based on a set of karyometric parameters of follicular cells and developed computer analyzer of color images is described here (Fig. 1,2). Main tasks of automated color images processing and binarization by applying of several developed segmentation algorithms, automatic raster-to-vector transformation and biological objects formation, morphometric assessment of biological objects by quantitative parameters characterizing the changes of cell nuclei and diagnostic rules formulating with

further diagnosis of thyroid cancer were done. “Contour” was developed by specialists from United Institute of Informatics Problems of The National Academy of Sciences of Belarus and Research and Clinical Institute of Radiation Medicine and Endocrinology [3,5].

“Cytron”

This system is morphological application of diseases diagnostic of human organs morphometrical investigations of tissue, cells and cell’s accumulation in human organs. This system is in developing in United Institute of Informatics Problems of The National Academy of Sciences of Belarus now [6].

On the base of form, size, color and morphologic structure of tissue and cells, the algorithms of cell segmentation and cell morphology structure extraction from histological images identify histology patterns. The system consist of software packages of image processing including filtering, binarization, segmentation, contouring, extraction and morphometric estimation of objects based on geometrical and densitometry features. The software of diagnostic approaches allow to detect indication of pathology in human organs and lesion degree or to confirm the absence of diseases automatically based on analysis of some sets of morphometric features through a database. Unique algorithms of tissue analysis allow to define more exactly diagnose by morphometry investigation on different optical magnification. The software package will be used for estimation of changes of cell morphological structures of different extent of lesion.

Conclusions

Among systems of general purpose «Bioscan-IW» is the most adapted system to carry out a histological investigations since it has specialized script for morphometry and larger number of measurement parameters than «Autoscan».

System “Contour” is specialized expert system which is only for thyroid carcinoma diagnostics purpose. “Cytron” is more universal system for oncology diagnostic, but now it is developed.

These systems meet the international specification and are used in medical organizations in Belarus.

This brief overview shows that among a wide spectrum of systems and technologies for image processing and interpretation created in Belarus there are four interesting examples of developments applied to histological investigations, which are differ in their functionality. The comparison of these systems by it functional properties are presented in the table below.

| Properties | Bioscan-IW | AutoScan | Contour | Cytron |
|------------------------------|--|----------------|-------------------|---------------------------|
| Number of measure parameters | 111 | 40 | 20 | 80 |
| Advanced measure statistic | Excel-like | Special report | Special report | Special report |
| Specialized scripts | yes | no | no | no |
| Expert analysis | no | no | thyroid carcinoma | Basic oncology properties |
| Advanced image processing | yes | no | no | Lite |
| Video input | VFW, Twain, Matrox. IEEE-1394, BitFlow | VFW, Twain | Twain | VFW, Twain |

Automation of morphology investigation in histology is one of interesting and complex problem. The several Belarusian teams are working in this field. United Institute of Informatics Problems of The National Academy of Sciences of Belarus, Belarussian State Medical University, and Belarussian State University are leader of histology automation. These organizations have not only developed computer system for histology investigation. They have many scientific achievements in such fields as cells extraction, tissue separation, morphomery automation, histology expert system and teleconsultation.

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