English
Research Express@NCKU Volume 27 Issue 4 - August 29, 2014
[http://research.ncku.edu.tw/re/articles/e/20140829/4.html]

Automatic Cell Segmentation and Nuclear-to-Cytoplasmic Ratio Analysis for Third Harmonic Generated Microscopy Medical Images

Gwo Giun Lee[1,*], Huan-Hsiang Lin[1], Ming-Rung Tsai[2], Sin-Yo Chou[2], Wen-Jeng Lee[2,3,5], Yi-Hua Liao[4,5,6], Chi-Kuang Sun[2,5], Chun-Fu Chen[1]

[1] Department of Electrical Engineering, College of Electrical Engineering and Computer Science, National Cheng Kung University
[2] Department of Electrical Engineering, Graduate Institute of Photonics and Optoelectronics, National Taiwan University
[3] Department of Medical Imaging, National Taiwan University College of Medicine
[4] Department of Dermatology, National Taiwan University College of Medicine
[5] National Taiwan University Hospital
[6]Molecular Imaging Center, National Taiwan University

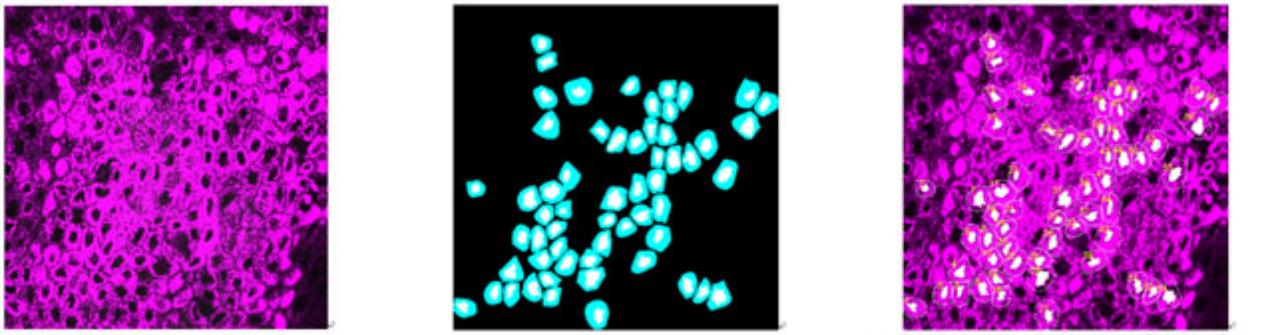
clee@mail.ncku.edu.tw

IEEE Transactions on Biomedical Circuits and Systems, vol. 7, Iss. 2 pp. 158-168, 2013.

Bio-medical engineering is an emerging research topic since this topic should combine experts in medical field and engineering field. Instead of computing lots of bio-medical images without the opinions from medical doctor, this paper was published through the effort that cooperated by experts in medical field, signal processing, optical physics. By integrating the knowledge from different disciplines, the captured bio-medical images can provide medical information to assist doctors in diagnose patients. Prof. Sun in molecular image center developed a system that is capable of taking snapshot of humans' tissue through the technology of optical virtual biopsy, so we are able to analyze lots of bio-medical images to supply variety information to medical doctor.

In Figure 1 (a), it is an image that displays a snapshot of human's skin in epidermis layer, and doctors usually analyze the ratio of nuclei-to-cytoplasm (NC ratio) as an index of the status of subjective.

For current analysis, NC ratio is usually performed manually; however, manual approach will suffer from several subjective problems, e.g. the mental state of examiner, doctors might make distinct decision when their experience are different, etc.. On the other hand, with the help of Prof. Sun, lots of data could be captured fast and multiple sampling-locations of one subject are also allowable; i.e., data size of to-be-analyzed data is too larger to handle them manually. Consequently, this paper present an automatic cell segmentation algorithm to evaluate NC ratio of each subject. The proposed algorithm consumes about 5 to 15 seconds to segment one image and the evaluated NC ratio could achieve the comparative results to manual evaluation. Moreover, with the professional sight of medical doctors, this algorithm could be used to establish a system that is capable of measuring the state of subjects. Figure 1 (a) displays the original bio-medical image of health subject; Figure 1 (b) shows the indicated cells, including nuclei (white color) and cytoplasm (cyan color); Figure 1 (c) delineates the boundary of cytoplasm and fills out the nuclei on Figure 1 (a).



(a) Orignal image (b) segmented cells (c) impose the contour of cytoplasm and nuclei on (a)

Figure 1 Experimental results of automatic cell segmentation algorithm