NOTT-UK

Authors: Yuexiang Li, Siu-Yeung Cho, John Crowe

Email: yuexiang.li@szu.edu.cn

Platform: Windows 7

Prerequisites: None

NOTT-UK: SUMMARY

This algorithm is designed to automatically track the changes in cell shape and position in a time-lapse video. The segmentation is based on local thresholding and has an excellent performance in low quality images. To track the detected cells in different frames, a frame-by-frame association using Euclidean distance as criterion is implemented.

NOTT-UK: PREPROCESSING

Due to the low quality conditions of the cell images, an existing enhancement method based on morphological operations [1], Top-Hat and Bottom-Hat, is performed before segmentation. The method can enhance the image contrast, which leads to better segmentation outcomes.

NOTT-UK: SEGMENTATION

Our segmentation algorithm is designed using local thresholding technique. The enhanced cell image will be firstly separated into sub-images. Then, the method will detect if there are cells or parts of cells in each of the sub-images by comparing their standard deviations with the one from the whole image. If there are objects detected in the processing sub-image, the method will perform the same enhancement approach used in the pre-processing step to deeply improve image quality. Followed that, Otsu thresholding technique is used to segment the sub-image. After all of them are processed, the outcomes will be placed together to generate the result. For some of the databases, such as **Fluo-N2DH-GOWT1**, even with enhancements, there are still cells in fragmentation. In that case, the proposed method detects the fragmented cells by calculating their roundness. If this parameter is lower than a pre-set value, the detecting area will be further enhanced and segmented to regenerate the shape of the cell being processed. Differently from other databases, the segmentation approach for **Fluo-C2DL-MSC** is established on the global thresholding technique. Because the gray scale distribution of the images in this database is relatively uniform compared to the others, it is more computationally efficient to use

global thresholding, instead of the local one. The pre-processing step is the same for this database. After that, Otsu thresholding is used to each of the frames to generate segmentation results.

NOTT-UK: TRACKING

Cell tracking is achieved by a frame-by-frame association. A segmented time-lapse sequence, which cells are all detected in each frame, is the input for the proposed approach. Center of gravity of the cell is chosen to represent cell's position. Hence, the method is designed to firstly calculate the centers of cells in the processing frame and the ones in the previous frame. Then, for every cell in the current frame, the approach calculates the Euclidean distances from the cell's center to the ones in the previous frame, and links the nearest ones to it. Obviously, this method may lead to many issues, such as one-to-many correspondence, in experiments. Therefore, related judgment criteria are designed for it. After cell linking in neighbor frames, if two or more cells are pointing to the same one in the previous frame, a division of the cell is deemed to happen. New labels are assigned to each of the cells in the processing image (one-to-many). In addition, if the minimum distance exceeds a pre-set threshold, which is the cell radius in our experiments, the processing cell is regarded as a new one appeared in the current frame and marked with new label (none-to-one). Conversely, cells in the previous frame will be marked as disappeared, if there is no cell in the current frame linked to them (one-to-none). Apart from frame-by-frame tracking, for the 3D database, like **Fluo-N3DH-CHO**, links between different layers are also needed. To achieve that, our proposed method starts with segmentations of the different layers. Then, it sums up the outcomes into one image, and performs cell tracking with the neighbor frame. According to the obtained labeled graph, the method finally marks the cells in different layers with corresponding labels.

NOTT-UK: POST-PROCESSING

No post-processing step is performed.

REFERENCES

1. Ye D, Zhao Y, Li D. The study of local contrast enhancement for MR images. 2005. p. 6-7.