ID-9-O-3081 HawkC: computer-aided 3D visualization and analysis software for electron tomography

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Electron tomography is widely used to obtain nanometer scale 3D structural information in cell biology and material science. Electron tomography includes four main steps: tilt-series acquisition, image alignment, 3D reconstruction and image segmentation (visualization/measurement). Especially, the image segmentation is time-consuming, and it is difficult to achieve complete automation because target objects with complex shape, low contrast and low signal-to-noise ratio are often included.

In this paper, we introduce a computer-aided 3D visualization and analysis software for electron tomography [1]. Figure 1 shows an overview of the developed software. The software provides multiple automatic contour extraction algorithms, which are based on a class of region-based deformable contour models called R-centipedes [2]-[4] and a threshold-based approach, and manual segmentation using user-friendly user interface. We named the software “HawkC” meaning fast and accurate extraction of contours in tomographic images like a hawk. Figure 2 shows the process of contour extraction from a tomographic image of a cell nucleus using R-centipedes. It is seen that nuclear membrane and chromatin in the cell nucleus can be extracted accurately from initial curves by using the contour extraction algorithm of deflationary and inflationary modes, respectively. Figure 3 shows a 3D view of final extracted contours from tomographic volume data without manual editing. HawkC is available for free download (http://hawkc.dynacom.co.jp/?lang=en) until 31 March 2015.


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Fig. 1: An overview of the developed 3D visualization and analysis software.

Fig. 2: Examples of automatic contour extraction: deflationary and inflationary modes.

Fig. 3: 3D Visualization of a cell nucleus using HawkC (no manual editing).