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Automated Segmentation of HeLa Nuclear Envelope from Electron Microscopy Images

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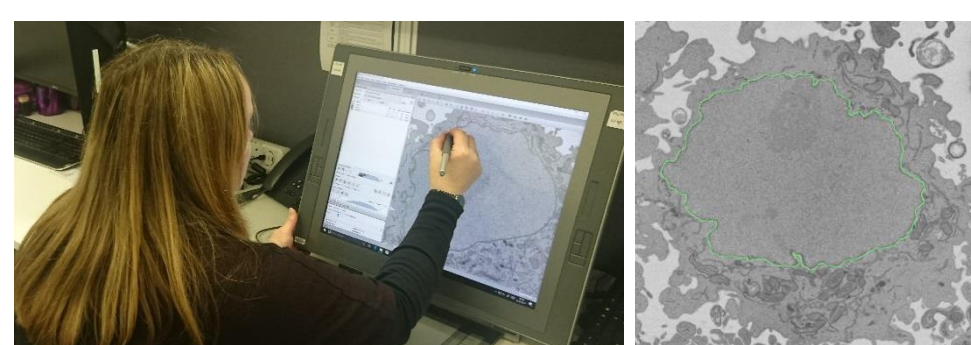
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Automated Segmentation of HeLa Nuclear Envelope from Electron Microscopy Images

(1) School of Mathematics, Computer Science and Engineering, City, University of London, UK (2) Electron Microscopy Science Technology Platform, The Francis Crick Institute, UK

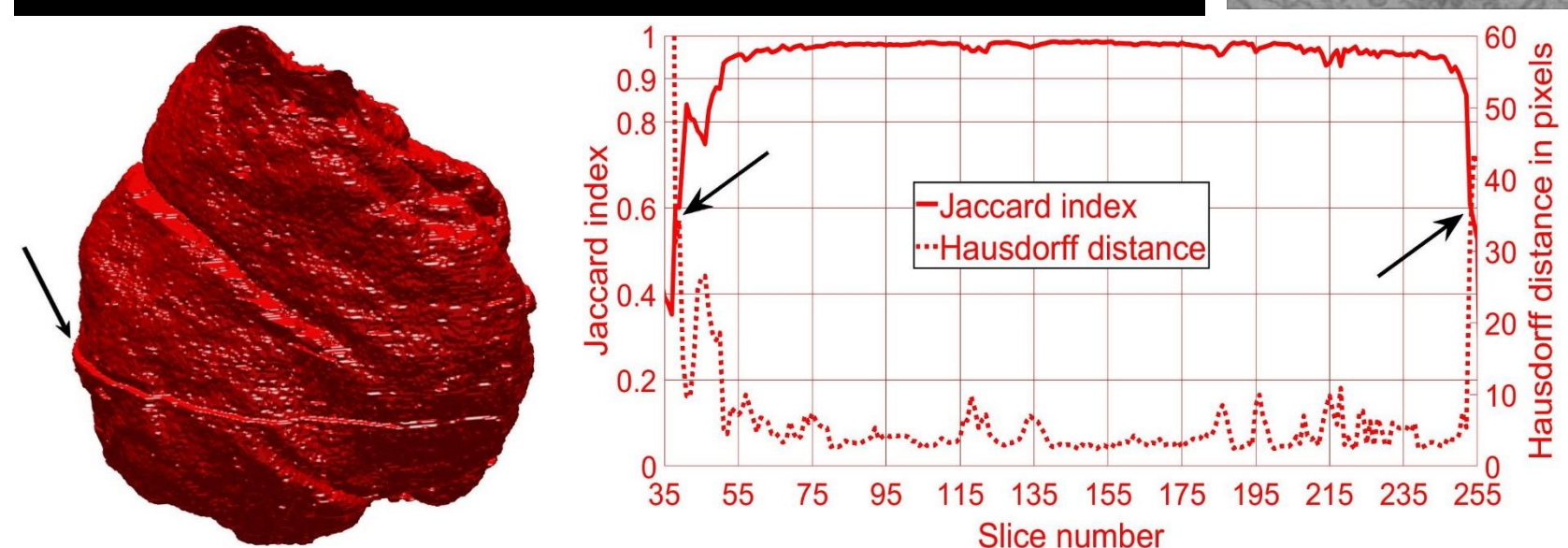
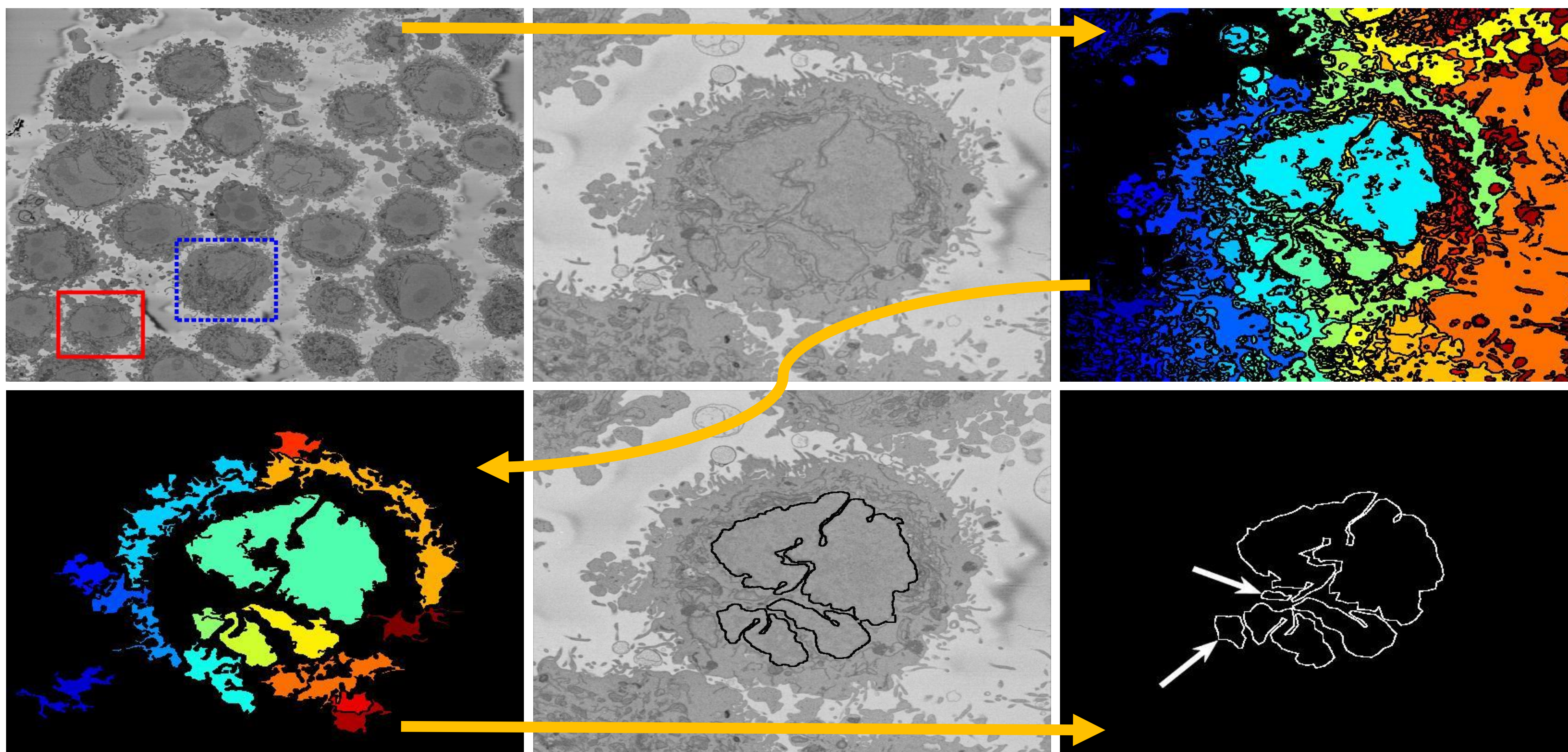


Abstract

This work describes an algorithm to segment the nuclear envelope (NE) of **HeLa** cancer cells from Electron Microscopy images. The algorithm is unsupervised, fully automatic, fast and processes one image in less than 10 seconds. Comparison with hand segmented ground truth reported Jaccard values 94% - 98% and Hausdorff distance 4-13 pixels and the algorithm outperformed segmentation with active contours. Code and data are freely available at <https://github.com/reyesaldasoro/Hela-Cell-Segmentation> and <http://dx.doi.org/10.6019/EMPIAR-10094>.

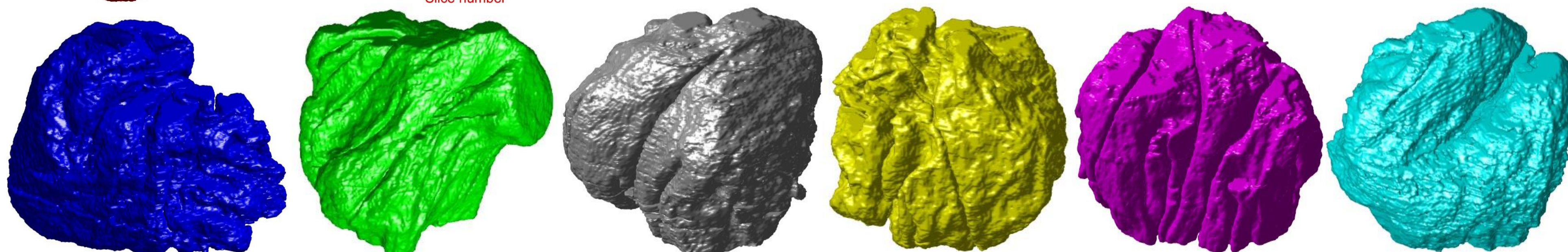
Materials & Methods

The data sets used in this work consisted of **EM images of cancerous HeLa cells**. Wild type HeLa cells were prepared and embedded in Durcupan resin following the method of the National Centre for Microscopy and Imaging Research (NCMIR). Serial blockface scanning electron microscopy (SBF SEM) data was collected to obtain 518 EM images of 8192 x 8192 pixels each, using a 3View2XP (Gatan, Pleasanton, CA) attached to a Sigma VP SEM (Zeiss, Cambridge). Voxels size was with 10 x 10 x 50 nm with intensity [0-255]. Initially the data was acquired at higher bit-depth (32 bit or 16 bit) and after contrast/histogram adjustment it was reduced to 8 bit. Seven individual cells were manually cropped as volumes of interest and each cell consisted of 300 slices with dimensions 2000 x 2000 x 1 and were saved as single channel *TIFF* files.

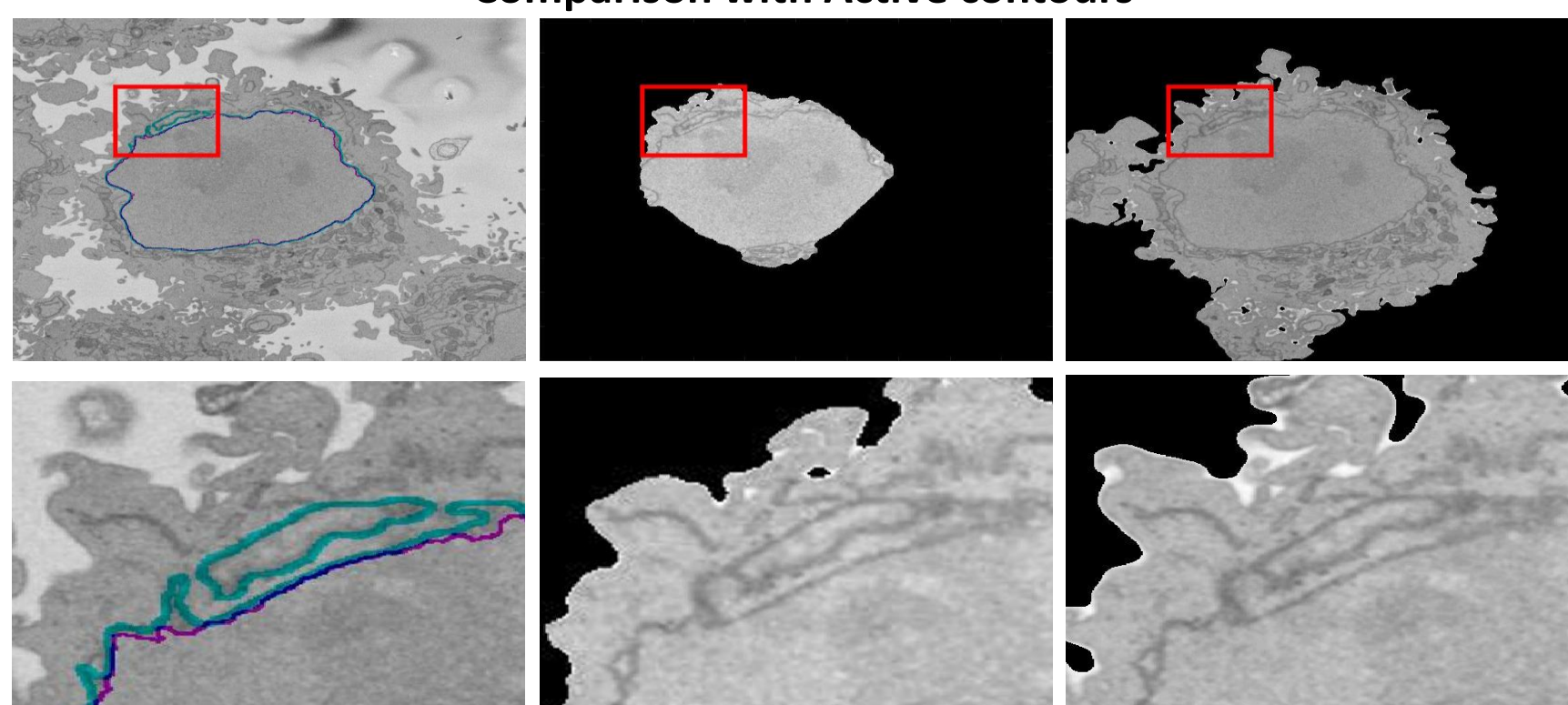


Results & Future Work

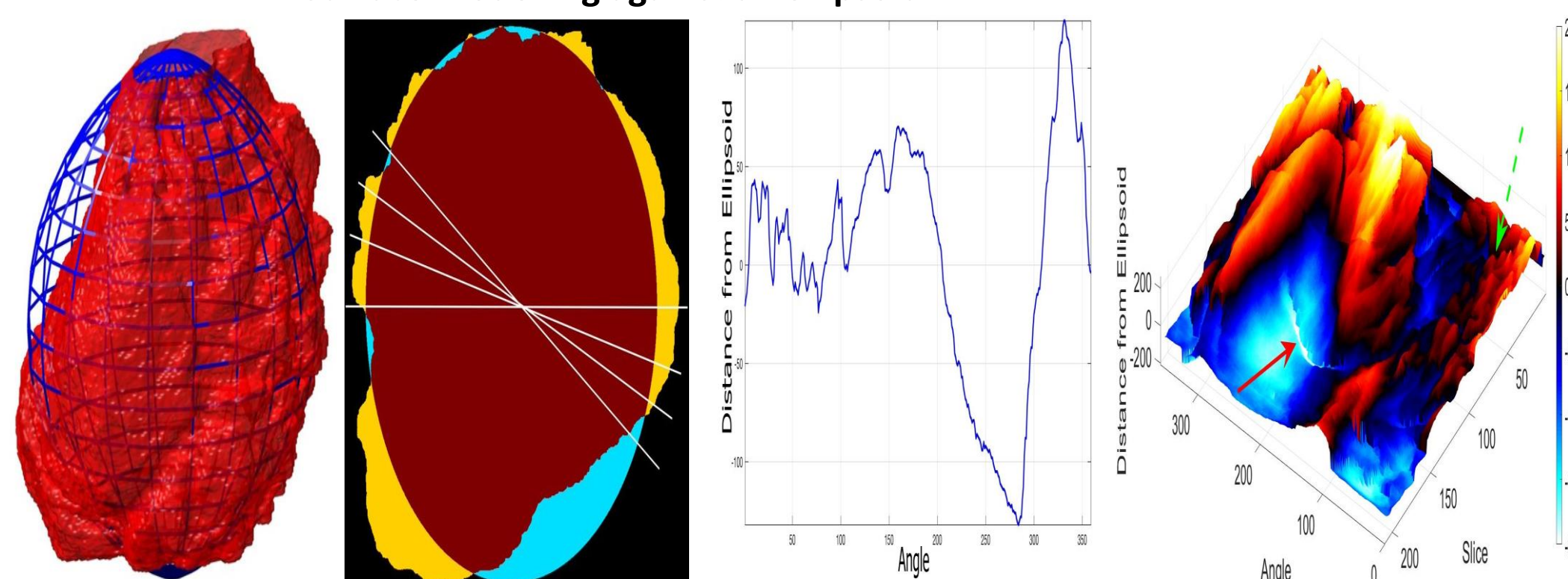
The **main contributions** of this work are: (a) a framework to segment the nuclear envelope of HeLa cells from SBF SEM images, which includes disjoint regions of the nucleus. (b) The **modelling of the NE** surface against an ellipsoid, which could reveal interesting biological characteristics of the nucleus. (c) The 2D maps of the NE surface, which can provide an easier way to assess the characteristics of a 3D structure. The framework is not restricted to **HeLa** cells as other cells from any electron imaging modality could be also analysed. **Future work** will consider the analysis of the whole cell, other cellular structures and the chromatin in the nucleus.



Comparison with Active contours



Surface Modelling against an ellipsoid



References: [1] Karabağ C, Jones ML, Peddie CJ, Weston AE, Collinson LM, Reyes-Aldasoro CC; Cham CCIS. Automated Segmentation of HeLa Nuclear Envelope from Electron Microscopy Images. In Proceedings Medical Image Understanding and Analysis July 2018;894:241–250. [2] Canny J. A Computational Approach to Edge Detection. IEEE Transactions on Pattern Analysis and Machine Intelligence 1986;8(6):679–698. [3] Jaccard P. Étude comparative de la distribution florale dans une portion des Alpes et des Jura. Bulletin del la Société Vaudoise des Sciences Naturelles 1901;37:547–579. [4] Chan TF, Vese LA. Active contours without edges. IEEE Transactions on Image Processing 2001 January;10(2):266–277. [5] Deerinck TJ, Bushong E, Thor A, Ellisman MH, NCMIR – National Center for Microscopy and Imaging Research. NCMIR methods for 3D EM: A new protocol for preparation of biological specimens for serial block-face SEM Microscopy; 2010. [6] Etch A Cell; 2015. <https://www.zooniverse.org/projects/h-spiers/etch-a-cell>. [7] I.S. Kim et al., “Computing the Hausdorff distance between two sets of parametric curves,” Commun. Korean Math. Soc., vol. 28, no. 4, pp. 833–850, 2013.