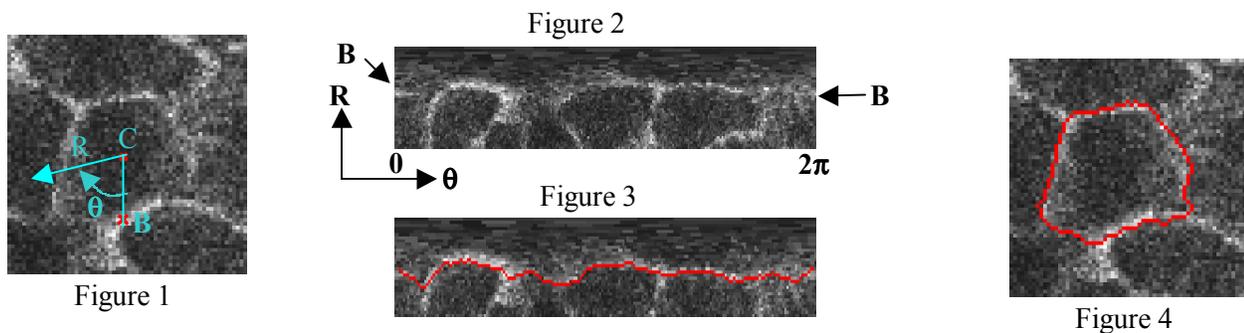


Segmentation of Whole Cells in Solid Tissue Sections

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Highly orchestrated cell-cell interactions govern the development and function of solid tissues. Therefore, understanding the underlying cellular and molecular basis of tissue development and function requires analysis of individual cells while in their tissue context. Consequently, we have developed software for identifying the optimum border around each individual cell, a process known as segmentation, from 2D microscope images of intact tissue labeled with a fluorescent cell surface marker. Since the fluorescence marker generally produces a brighter signal at cell borders compared to elsewhere, the optimum border around a given cell was defined as the border that has an average intensity per unit length greater than any other possible border around the same cell. Implementation of the algorithm required the user to indicate two points for each cell, one approximately in the center of the cell and the other on the border of the cell (Red dots labeled C and B respectively in figure 1). This level of interaction was not overly burdensome thus facilitating analysis of relatively large numbers of cells per image, and it ensured that 100% of analyzed cells were accurately segmented. Henceforth, the segmentation was automatic. The algorithm first performed a Cartesian to polar coordinate remapping on the region of the image centered on point C so that the looped border around the cell became a horizontal, but not straight path (figure 2). Then using dynamic programming based on the grey-weighted distance transform (“An efficient uniform cost algorithm applied to distance transforms”, B.J.H. Verwer, P.W.Verbeek, and S.T. Dekker, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 11, no. 4, 1989, 425-429.) the optimum path was determined from point B on the left edge to point B on the right edge of figure 2. The result is shown in figure 3. The final step reversed the transformation in the initial step (figure 4). The method is highly robust, because intermittent labeling of the cell borders, diffuse borders and spurious signals away from the border do not significantly affect the determination of the optimum path. Work in progress will extend the method for detecting the surface of whole cells in 3D images of tissue.



This project has been funded in part with Federal funds from the National Cancer Institute, National Institutes of Health, under contract NOI-CO-56000. The content of this publication does not necessarily reflect the views of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.