Abstract ID: 17780  
Title: A Novel Interpolation Method for the 3D Reconstruction of Cell Structures

Purpose: To develop a new interpolation method for accurate 3D reconstruction of cell morphology from laser scanning confocal microscope (LSCM) image data.

Methods: Current techniques are based on the assumption that pixel intensity or contour shapes of images change linearly in the interpolation direction. Gray-value and position of the pixel in interpolated image slice are obtained through weighted average calculation with gray-values and distances of corresponding pixels in two adjacent original image slices, only information from adjacent image slices is considered, often fail to meet the need of 3D reconstruction for cells because of the complex cell morphology.

The new method interpolates cellular organelle contours in polar coordinate system. Coordinate system origin is chosen to be the mass center weighted by pixel intensity instead of conventional geometric center, contour points of the organelle is sampled by their angles first and fitted with uniform cubic B-spline to perform interpolation. For complex organelle structures such as branched nuclei, a special method combining morphological information and corner detection technique based on curvature scale space has been developed to solve the contour division and related problems. New method was applied to confocal images of 130 different cells acquired with an LSCM system (LSM510, Zeiss), sampling step was set as 0.5 µm in longitudinal direction, pixel size in horizontal plane was 0.07 µm and the resolution was 512x512. Marching cubes algorithm was used for 3D reconstruction.

Results: Experiments showed that reconstructed 3D images with new method have much smoother and more valid organelle surfaces for both cytoplasm and nucleus than those from conventional methods.

Conclusions: The new interpolation method can significantly improve the quality of 3D reconstruction and serve as a valid and effective tool for quantitative study of 3D cell morphology in radiation biology and other areas of life science.

*support by NSFC-81171342

Funding Support, Disclosures, and Conflict of Interest:

Supported by the National Science Foundation of China (NSFC-81171342)

Conflicts of interest: None.