Limitations in 3D reconstruction of X-rays tomography

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To reconstruct the 3D information of X-rays tomography (tomoX). many authors [1, 2, 3, 4] uses algorthims implemented for electron microscopy ([5, 6]) To analyze the performance of applying EM reconstruction algorithms to tomoX microscopy we have developed an X-ray microscope simulator. This simulator combines a image formation model based on the volume information, with the characteristics of zone plates Fresnel lenses to generate the specific Point Spread Functions (PSF)[7] for each plane of the volume. In the best focused plane, we obtain a resolution of 1.22 times the width of the outer ring of the zone plate, becoming for the rest of planes a defocus effect. The differences between EM tomography and tomoX are not only the blurr effect of the optical system (Figure 1), but the influence of the depth of field along the field.

We use the experimental reconstruction of the soma of an astrocyte in stratum radiatum of hippocampal area CA1 of an adult mouse, obtained by M. Ellisman et als. [8] from 26 single tilt reconstructions. We simulate the projections using two configurations of zone plates. The first Fresnel lens is characterizeb by a number of 560 zones and outermost zone width of $dr_N = 40\ nm$ (1.5mm focal length). The second lens has 900 zones and $dr_N = 25\ nm$ (0.925mm focal length), being both projections simulated for a illuminating wavelength of 2.43nm. We will also simulate EM tomography in two ways: applying and not the blurr effect of the microscope, and compare these reconstructiosn with the ones obtained from tomoX (Figure 2). [9]

Bibliography

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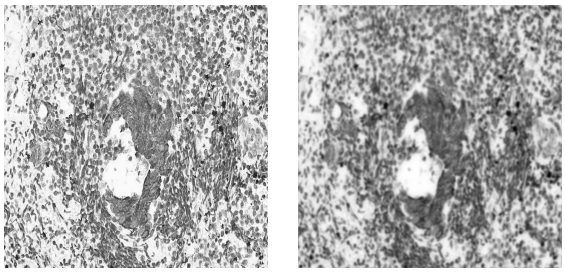
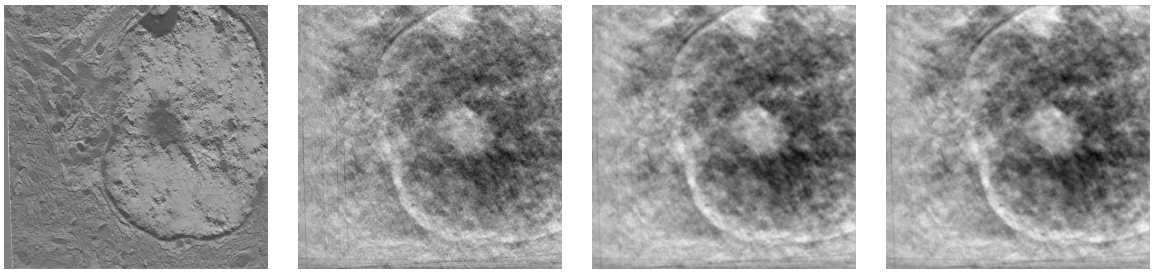
[9] This work was funded by the European Union (UE-512092), the Spanish National Council of Scientific Research (CSIC, PIF08-020), the Spanish Ministerio de Ciencia e Innovación (CSD2006-0023, BIO2007-67150-C01, BFU2007-60228, BFU2009-09331) and the Comunidad Autónoma de Madrid (S-GEN-0166-2006, CCG08-CSIC/SAL-3442) and by Award Number R01HL070472 from the National Heart, Lung, And Blood Institute. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung, And Blood Institute or the National Institutes of Health.



(a) (b)

Figure 1: Example of the blurr effect performed by a X-ray zone plate charaterized by 560 zones and focal length of 1.5 mm when a sample tissue of 5 μm is observed. (1(a)) Image without PSF effect; 1(b) with PSF effect.



(a) (b) (c) (d)

Figure 2: Example of the blurr effect performed by a X-ray zone plate charaterized by 560 zones and focal length of 1.5 mm when a sample tissue of 5 μm is observed. (1(a)) Image without PSF effect; 1(b) with PSF effect.