# Image distortion compensation in scanning electron microscope using a non-parametric model

## Research framework

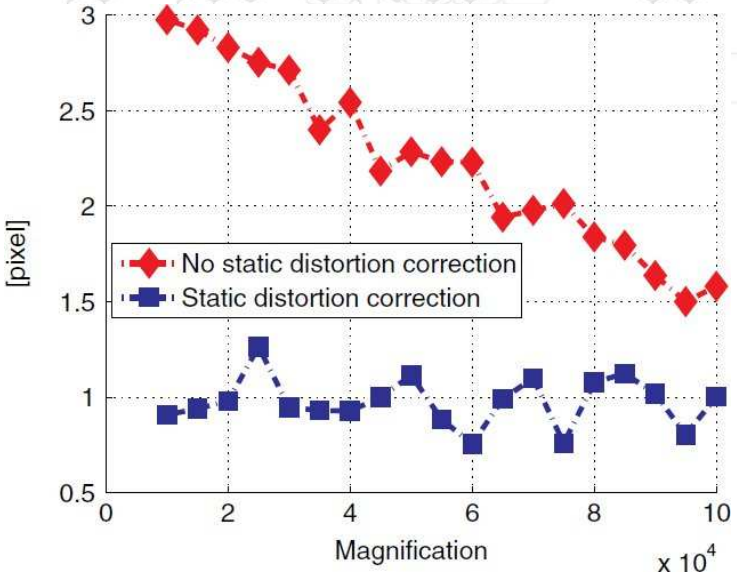
As optical microscopes, the scanning electron microscopes can deliver images affected by pixel distortions. Generally, the level of distortion is inversely proportional to the magnification. The distortion of a pixel comprises a radial component and a tangential component. Distortions compensation is a very important action if one want to use SEM images to make accurate measurements in the whole image area. For this purpose the polynomial model of the distortion is usually considered. This leads to iterative and long calibration methods. For the scanning electron microscope images, this work explores an alternative solution.

## Proposed approach

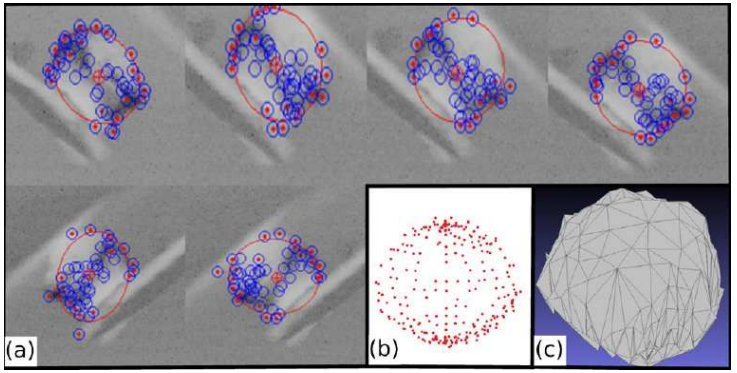
In this work, a non-polynomial model of radial and tangential components of the distortion is considered. It includes a distortion center (a priori different from the principal point), a parameter of radial distortion and a parameter of tangential distortion.

Initially the center of distortion is estimated by neglecting the tangential distortion. It is obtained from the fundamental matrix reflecting the geometric constraint between the calibration grid points and their images. In a second step, both radial and tangential parameters are taken into account and calculated using a bundle adjustment.

The concepts were successfully applied to images providing from a scanning electron microscope with a tungsten filament for magnifications ranging from 100x and 10 kx (JEOL-JSM 820).




RMS projection error with respect to magnification (JEOL-JSM 820 SEM)




Application to 900 nm ball deformation measurement: some tracked points (a), the 3D point cloud, the 3D reconstructed model

**Major article:** Malti, A. C.; Dembélé, S.; Fort-Piat, N. L.; Rougeot, P. & Salut, R. Magnification-Continuous Static Calibration Model of a Scanning Electron Microscope Journal of electronic imaging, 2012, 21, 033020.

Contact: sounkalo.dembele@femto-st.fr, nadine.piat@ens2m.fr

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