

3D reconstruction of surfaces from the analysis of image sharpness

Research framework

The main property of microscopes (optical as well as electronic) is the relative weakness of their **depth of field**: about 3 microns for a 10X optical microscope, about 5 microns for a 1000X scanning electron microscope (SEM). This makes difficult the use of microscopes to image 3D-dynamic scenes with large depth of view involved in micro-nanorobotics tasks.

Conversely, this property can be used to perform **3D-reconstruction of scene surfaces**. Indeed, low depth of field causes a high sensitivity of image sharpness to the relative position of the microscope with scene: sharpness codes on this position and can be used to determine it.

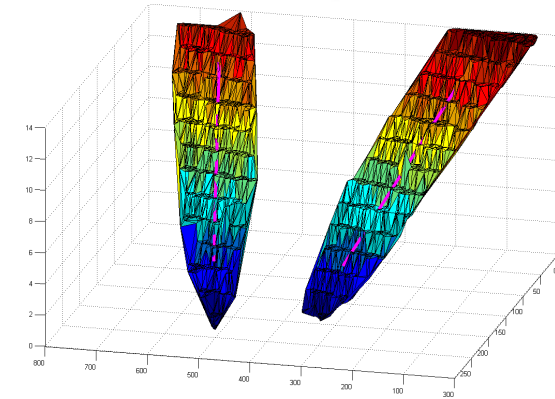
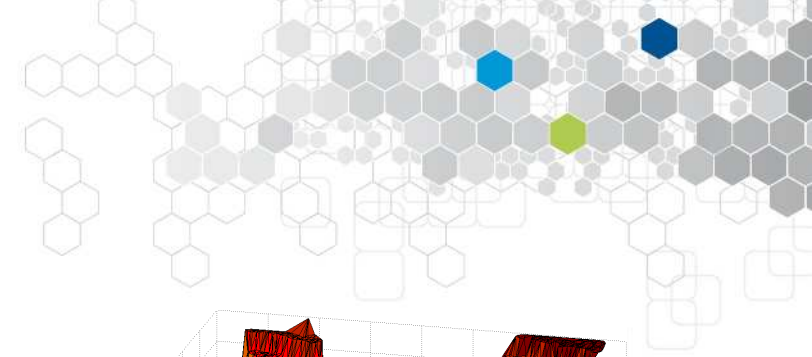
Proposed approach

The main stages of the developed method are:

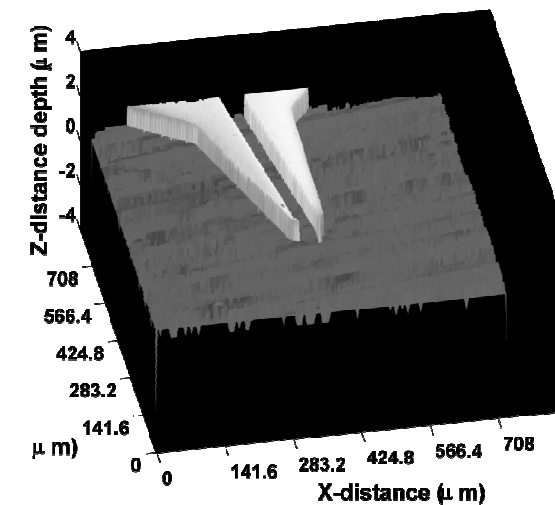
- Acquiring a set of images with respect to the working distance,
- Cleaning of images to remove outliers,
- Calculating sharpness of each pixel using the appropriate function,
- Detecting, for each pixel column, of the pixel outputting the maximum sharpness,
- Filtering of 3D points obtained.

Major article: Naresh Marturi, Sounkalo Dembélé and Nadine Piat. Depth and shape estimation from focus in scanning electron microscope, IEEE Int. Conf. on Control, Automation, Robotics & Embedded Systems (CARE) 2013, Dec 16-18, India.

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



3D-reconstruction of the surfaces of a micro-gripper observed with an optical microscope



3D reconstruction of the surfaces of a micro-gripper observed with a SEM



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