# 3D reconstruction of AFM tip by using known tip characterizers

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Atomic Force Microscope (AFM) is a widely used technique to measure topographies at the nanoscale. AFM images are due to the convolution of the sample shape, the tip shape and the tip-sample-substrate interactions. While AFM height measurements can achieve sub-nanometer resolution and accuracy, lateral resolution is influenced by several factors, the most impacting is the tip shape.

Several methods for AFM tip reconstruction are presented in literature, and we focused on in situ characterisation using known tip characteriser (e.g. bionanostructures and complex-shaped nanoparticles, with known reference dimension and crystalline structure respectively).

In order to reconstruct the tip shape from the reference nanoparticle measurements, an algorithm exploiting a geometrical reconstruction is initially developed. This one-dimensional approach is then generalized to any structures in a 3D space, by using a ray tracing algorithm.

In this study we create a Python module that generate the ideal topography of the tip characteriser, and then reconstructs the tip shape by eroding the real measurement with the generated structure.

The study of the shape and size of AFM tips is important for studying candidate reference materials in different fields:

1. in the dimensional field, to study the critical dimensions and morphological descriptors of nanoparticles in a robust and traceable way;
2. in the biological field, to carry out traceable nanomechanical measurements of biological and soft materials; these measurements will contribute to the early diagnosis of cancer.