Robust optimization of AFM cantilevers

Master Project Proposal

Aim of this project is to use robust topology optimization techniques to design new type of cantilevers for atomic force microscopy. Atomic Force Microscopy (AFM) is a technique that enables us to see and manipulate materials in nano scale where the objects are even smaller than the wavelength of the light (Fig1.1). It uses a probe consisting of an extremely sharp tip and a Micro cantilever (Fig.1.3). When the tip is in closed proximity of the surface its mechanical properties change, and by monitoring these changes the topography of the surface can be imaged.

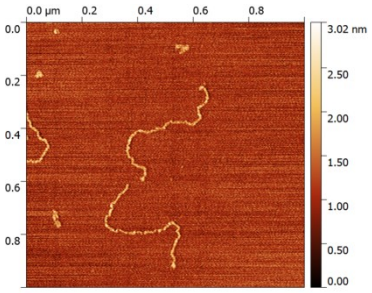

Fig1.1) DNA image (size: 1.2 nm)

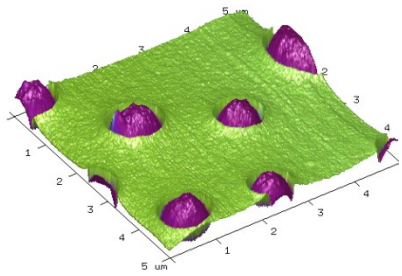

Fig.1.2 material properties detection

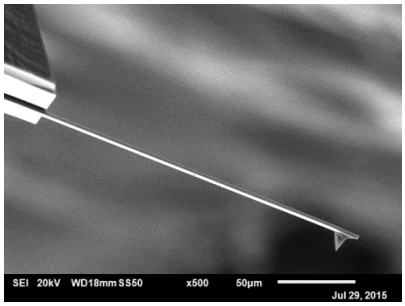

Fig.1.3 an AFM probe

According to some research in our group, the shape of the cantilever plays an important role on dynamics of the probe and consequently on sensitivity and imaging performance of the AFM. For example, using some special cantilevers, it is possible to also detect the material properties of samples as well as the topographical images (Fig.1.2), although it not easy to fabricate these cantilevers very precisely. Thus, in this project we would like to optimize the shape of the cantilevers to enhance the performance of the probes while considering the fabrication uncertainties. In this manner even if the designed probe is not fabricated precisely, its performance will remain acceptable (Fig.2).

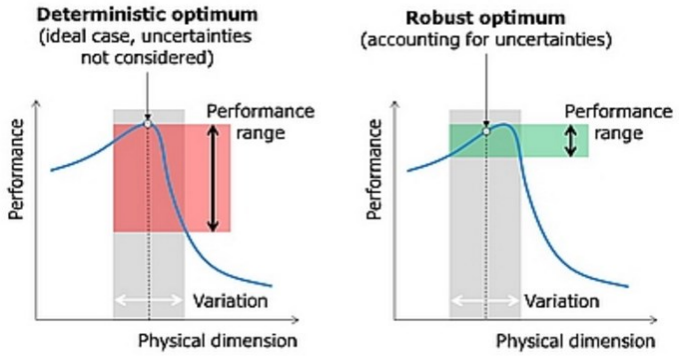

Fig.2 concept of robust optimization. [PhD project of Samee ur Rehman]

Requirements:

We are looking for enthusiastic student interested in topology optimization, robust optimization and dynamics of structures

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