

## Engineering Tripos Part IIA Project, SG1: Atomic Force Microscope, 2017-18

### Leader

[Dr T O'leary](#) [1]

### Timing and Structure

Thursdays 11-1pm and Mondays 9-11am plus afternoons

### Prerequisites

3F1 and 3F2 useful

### Aims

The aims of the course are to:

- Understand the basic functioning of an Atomic Force Microscope
- Develop models for a piezo-electric translation stage and design controllers to compensate for its natural resonance, while still providing a sufficiently fast and accurate response.

### Content

An Atomic Force Microscope (AFM) is a fairly new instrument in the area of Scanning Probe Microscopy (SPM) that is capable of imaging with extremely high resolution. It can resolve single DNA strands, measure nano-Newtons and determine friction coefficients of microscopic materials. In this project students will work with a custom-made AFM. There is a significant focus in this project on the modelling and control of a piezo-electric translation stage, which is used to take scans.

### FORMAT

Students will work in teams of two, with each pair sharing an AFM.

### ACTIVITIES

- Week 1: Familiarisation with the procedures of using the AFM. Compute and then measure the gain of the /optical lever/, which is the enabling technology of an AFM and which determines its resolution. Write first interim report.
- Week 2: Collect experimental data from the AFM for modelling. Hand measurement of the resonant frequencies. Develop spectral and parametric linear models in Matlab. Write second interim report.
- Weeks 3 and 4: Develop controllers in Matlab and implement on the AFM. Takes various scans. Investigate three post-processing techniques in Matlab that will improve the image quality. Write final report.

### Coursework

Coursework	Due date	Marks
Interim report 1	Thu 17 May 2018	15

Interim report 2	Thur 24 May 2018	15
Final report	4pm Thu 7 June 2018	50

### Examination Guidelines

Please refer to [Form & conduct of the examinations](#) [2].

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### Links

[1] <mailto:tso24@cam.ac.uk>

[2] <https://teaching22-23.eng.cam.ac.uk/content/form-conduct-examinations>