Engineering Tripos Part IIA Project, SG1: Atomic Force Microscope, 2018-19

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 Microsope
- 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.
- Gain practical laboratory skills and an appreciation of what is involved in getting sensitive apparatus to deliver good quality data

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. Please note: a necessary and important part of the project is developing patience, manual dexterity and an ability to troubleshoot practical problems. A goal of this lab is to develop an appreciation of the issues that can arise in turning theory into a practical application - this is fundamental to engineering.

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 16 May 2019	15
Interim report 2	Thur 23 May 2019	15
Final report	4pm Thu 6 June 2019	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://teaching21-22.eng.cam.ac.uk/content/form-conduct-examinations