Project 4: Simple adaptive optics for microscopy
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Goals: To build a simple adaptive optical system, in the form of an auto-focussing microscope using an electrically tunable lens. To be able to program a control system using image information to determine the optimum focal position. To understand the principles of adaptive optical microscopy.

Skill Set: Optics; alignment; simple programming; feedback control systems.

Day-to-day:

Tuesday: Setting up the optics for illumination, magnification and imaging onto a camera. Grabbing of images using the computer program provided.

Wednesday: Implement focus control using the tunable lens via the computer program provided. Test the use of an image quality metric to indicate location of focal plane. Adapt the program to search for the optimum focal position.

Thursday: Implement automated focal tracking. Investigate further properties of the adaptive optical system (optional, should time permit).

Friday demo: Adaptive optics aberration correction in widefield fluorescence microscopy

Using a custom built fluorescence microscope incorporating a deformable mirror to correct for specimen-induced aberrations. Understand how the concepts used earlier in the week can be extended to more complex adaptive optics systems.

Presentation Goals:

- Outline the important features of the autofocus microscope.
- Explain the principles of image-based feedback in an adaptive optical microscope and how this can be applied to the autofocussing system.
- Explain how these concepts are extended in order to compensate complex aberrations in a full adaptive optics microscope.