Bill Crossland – 3D Printing Optical & Decorative Parts

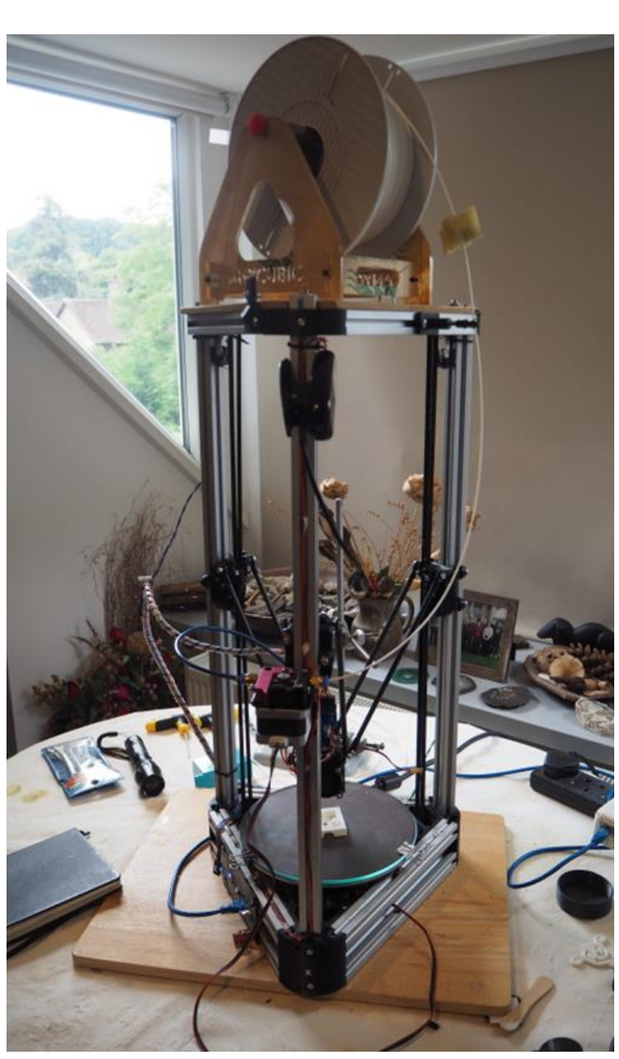
I experiment a lot with optics and always need holders for optical bench components like lenses, diffraction gratings, lasers etc. Commercial optical benches and components are beyond my means and often their high precision is not required for my work.

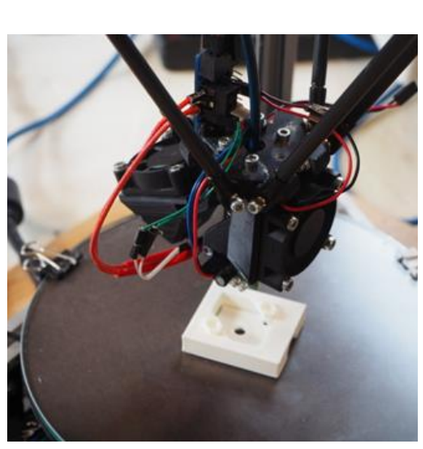
Simple 3D printed components can solve both problems, so I decided to build myself a 3D printer. This is partly for my own interest and sometimes for clients.

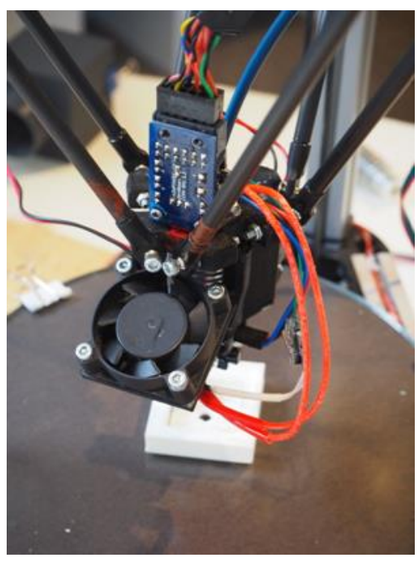
My machine

The 3D printer I use is a homemade Mini Kossel, built to the RepRap designs. Many companies offer versions of the RepRap design and for a mini Kossel this is quite a low cost way to acquire the basic frame and transport motors. I purchased the basic components from Think3D, but they do not supply mini Kossel parts now.

My machine is fitted it with a E3B V6 all-metal hot-end, an Anycubic RepRap Mk8 extruder, DUET WiFi electronics and DUET infra red reflector bed flatness sensor. The electronics are the most expensive part of my set up -- but are very flexible.







The print volume is about 180 mm diameter and 230 mm high

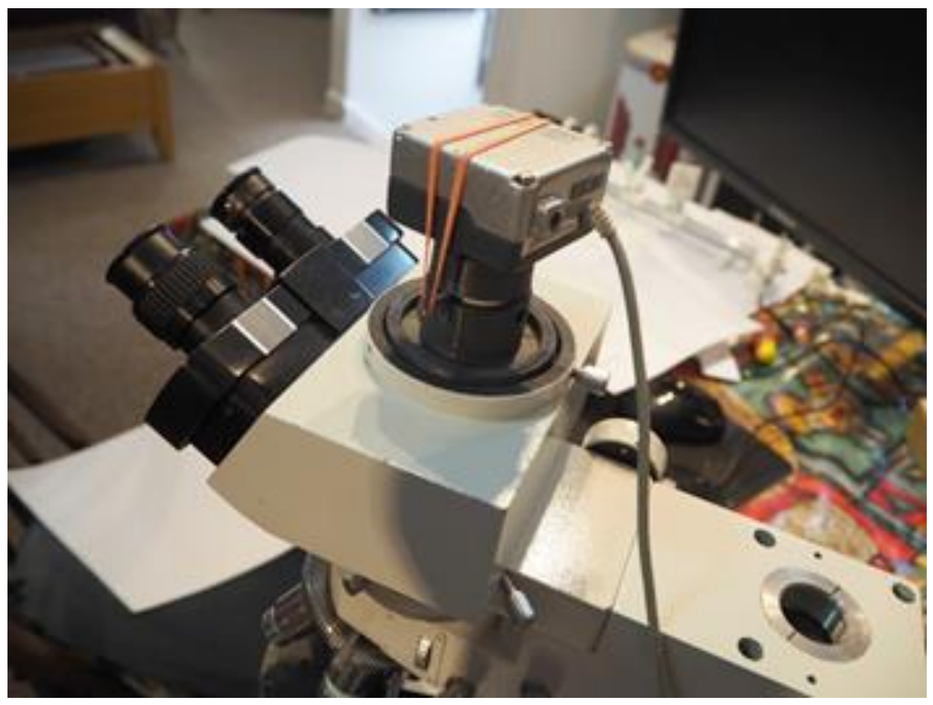
I use ABS plastic filament (printed at about 250°C) for 'engineering' parts and PLA for 'decorative' parts. Both plastics come as a 1.75 mm filament and the printer has a 0.40 mm nozzle. The printed layer height is about 0.30 mm.

I normally control the bed flatness to be better than 20µm and I would expect the XY accuracy to be better than this (due to the geometry of the Kossel machine).

My optical applications of 3D printing

I examine and measure liquid crystal cells and devices using a Vickers polarising microscope that was designed for old analogue cameras. The microscope has the problem that any camera adapter tubes and wave-plates, and polarisers, are either very expensive or unobtainable. To solve this I designed and 3D printed adaptors to use.

I also designed and 3D printed simple optical bench arrangements of components.

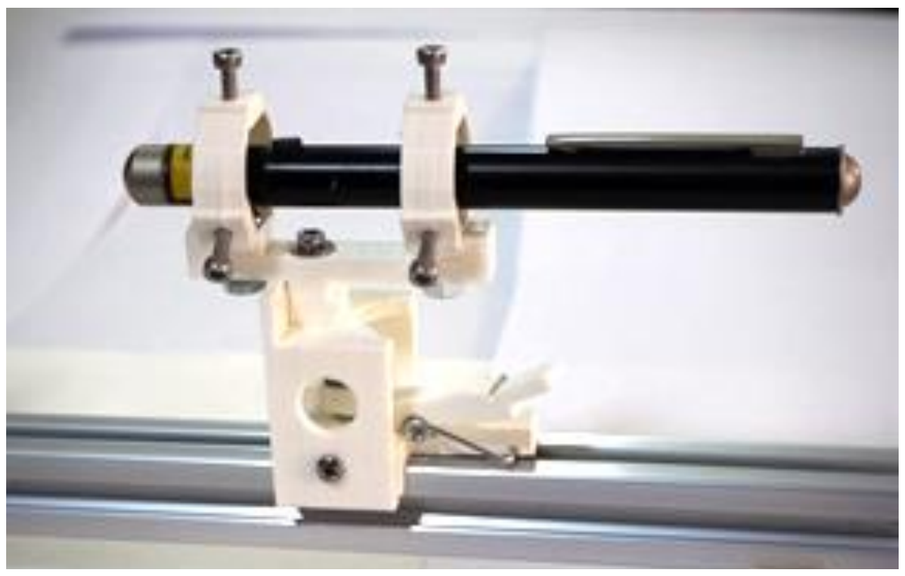


Examples of 3D printed microscope components I currently use.

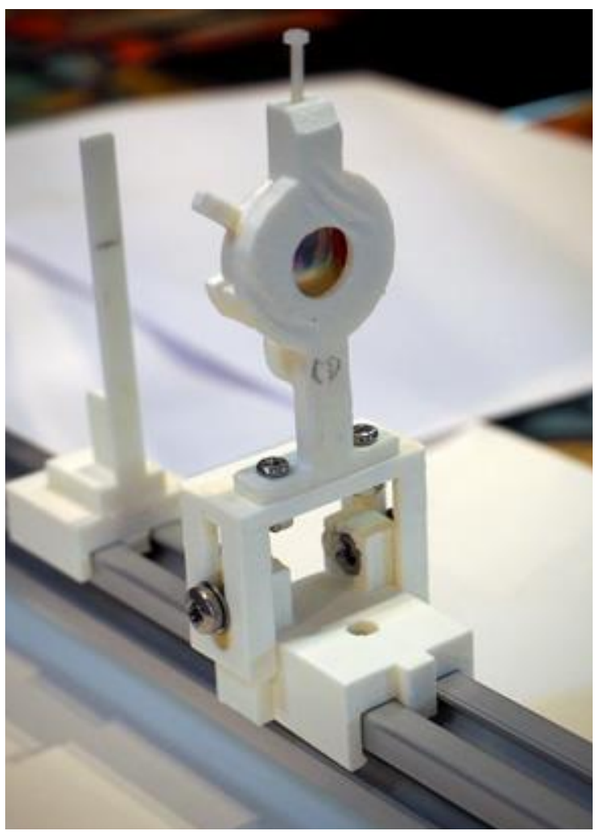
- Adapter tubes for fitting a digital camera.
- Adapter plates to allow available low-cost wave-plates etc. to fit the microscopes non-standard wave-plate slots.
- Aperture plates to repair and adjust the microscope’s sub-stage condenser.
- Various jigs, slide holders and devices for assembling microscope slide samples using UV curing resins.

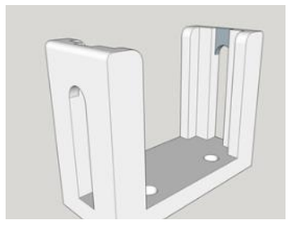
Examples of 3D printed simple optical bench components made so far.

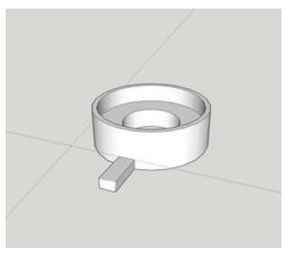
- Adjustable holders for attaching ‘laser pen’ lasers:



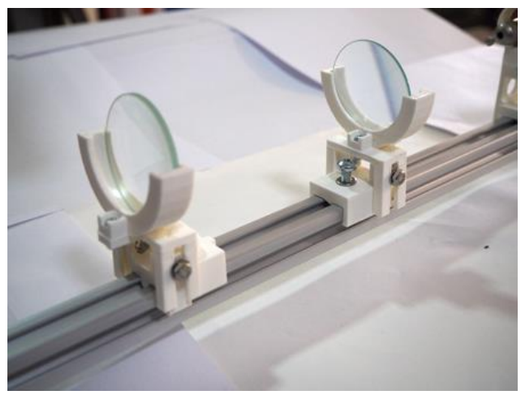
- Adjustable lens holders of various designs:

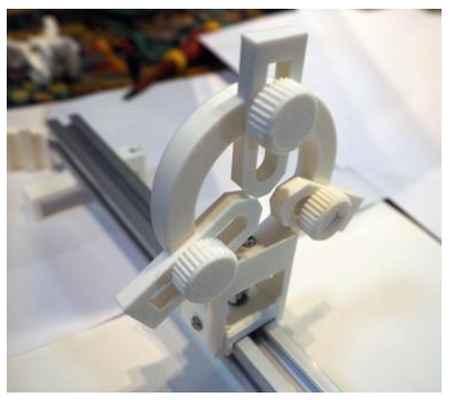


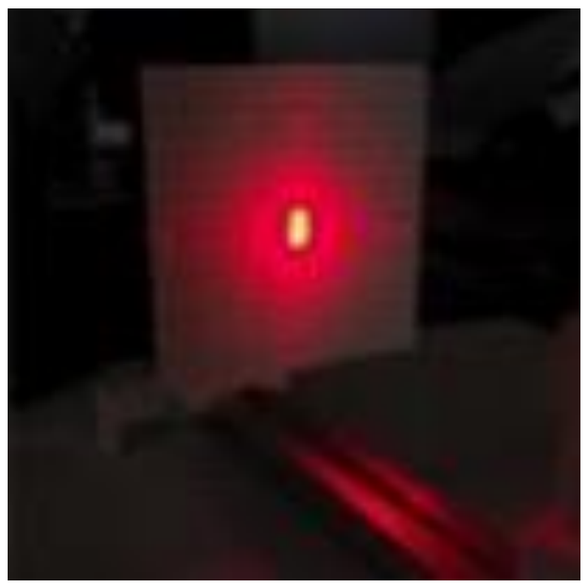




- Rotating holders for fitting polarisers, wave-plates and codification gratings to the rail.
- Holders for attaching and rotating beam splitting prisms
- Adjustable mounts for mirrors, liquid crystal devices or photo detectors.
- Optical bench rails uses 20 x 20mm T-section aluminium rail with the components attached Lego-like or bolted in place.
- Holders for a liquid-crystal-over-silicon (LCOS) device for a projector. The diffraction pattern from the 10µm pixel array is shown.







My other use of 3D printing

I also print decorative parts, mostly in PLA, as embellishments to the furniture that I make etc.

- Decorative plaques (painted)
- Gilded decoration for stair rails
- Edge decoration for bookshelves.