



openflexure
microscope

Microscopy for Everyone

Julian Stirling & Joe Knapper

FOSDEM'25

The OpenFlexure Microscope



openflexure
microscope

Motorised, digital,
laboratory-grade microscope

Mechanical stage is 3D printed

Design optimised for plastic (not
a cheap imitation)

Anyone can reproduce the design,
all project information is open

Focus on medical, research, and
educational use.



3D printing a microscope?

Traditional microscopes use
dovetails
Requires precision machining

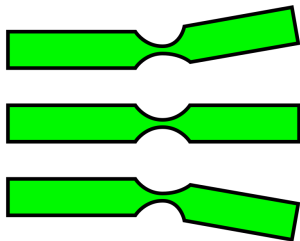


3D printing a microscope?

Traditional microscopes use dovetails
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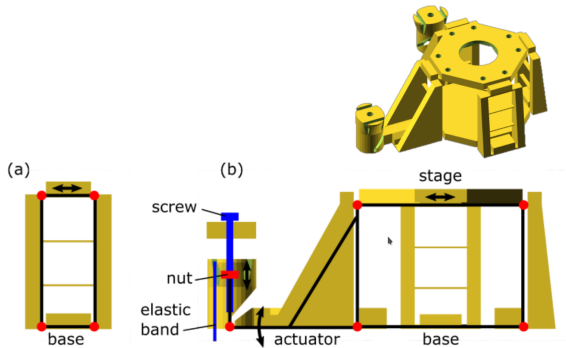


We use 3D printed flexures



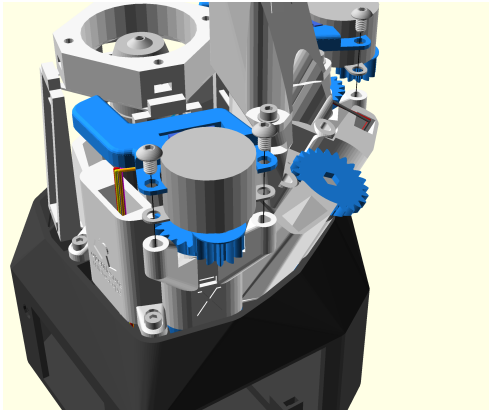
3D printing a microscope?

A single 3D print can create a 3D mechanism.



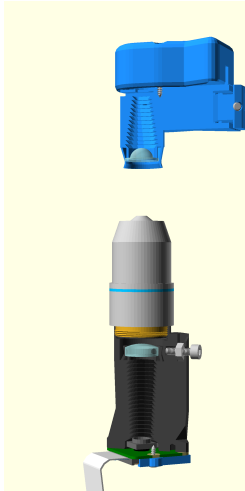
3D printing a microscope?

A single 3D print can create a 3D mechanism.
Add stepper motors for 100nm control.



3D printing a microscope?

Mount easily available optics and camera



Do I need a microscope?

Do I need a microscope?

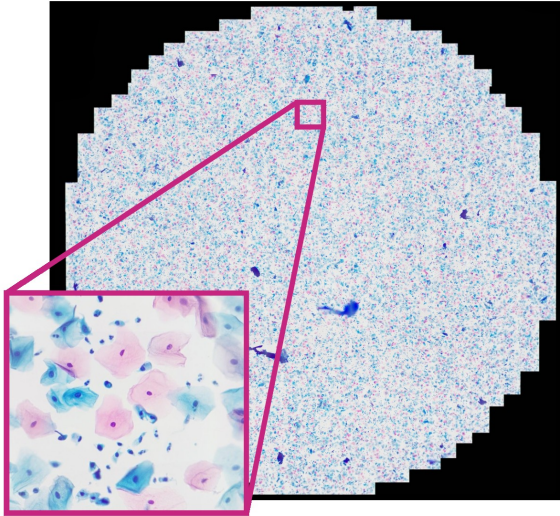
Probably not.

Do I need a microscope?

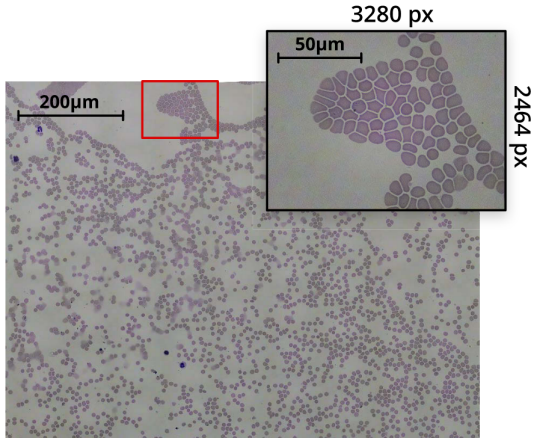
Probably not.

But you better hope your doctor has one!

Why do we need a medical microscope?



Why do we need a medical microscope?



Why do we need a medical microscope?



How much does a commercial microscope cost?



Purchase cost \sim €30,000



Maintenance: Parts cost + engineer travel

Why build another medical microscope?

How much does a commercial microscope cost?



Purchase cost \sim €30,000



Maintenance: Parts cost + **engineer travel**

Can we design a microscope that is:

- Understandable by many
- Community can suggest changes
- Has variations for different purposes
- Useful for hobbyists, researchers, and education
- Can be used in a medical product across the world

Medical device design requires:

- Clear version control
- Control of what goes into the design
- Design risks assessed
- Clear, concise, up-to-date technical documentation

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How hard is it to do this in the open?

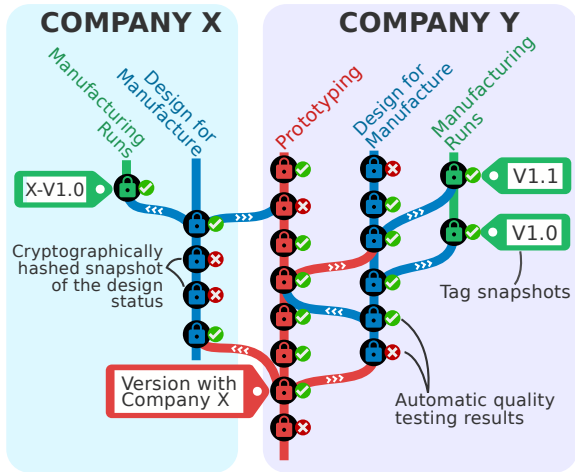
Remote hardware design collaboration is hard!

Most PLM software is proprietary and eye wateringly expensive...

Remote hardware design collaboration is hard!

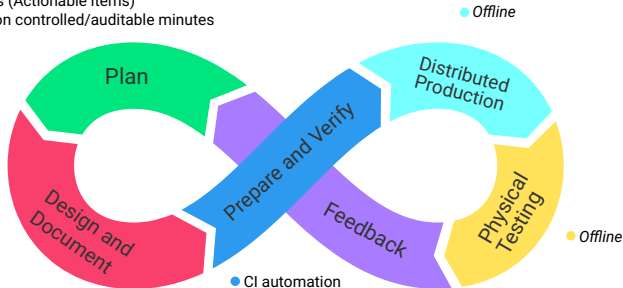
Most PLM software is proprietary and eye watering expensive...

but if we use code CAD we can use Git!



HardOps

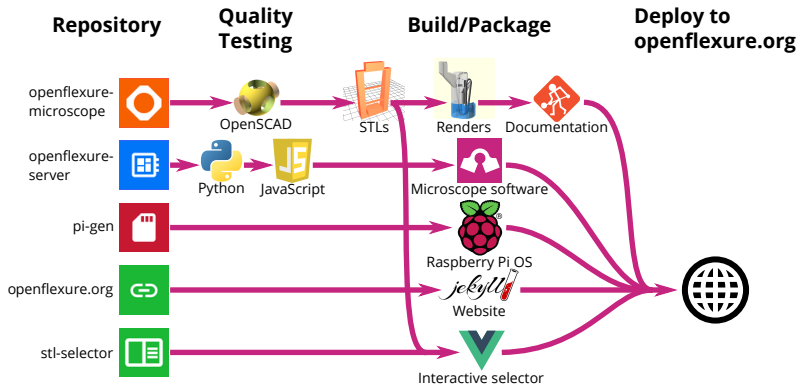
- Project management (Milestones, Assingees, etc)
- Issues (Actionable items)
- Version controlled/auditable minutes



- Version tracking
- Merge requests discussion and review
- Display bundled documentation

- Create issues/incident report
- Discuss open merge requests

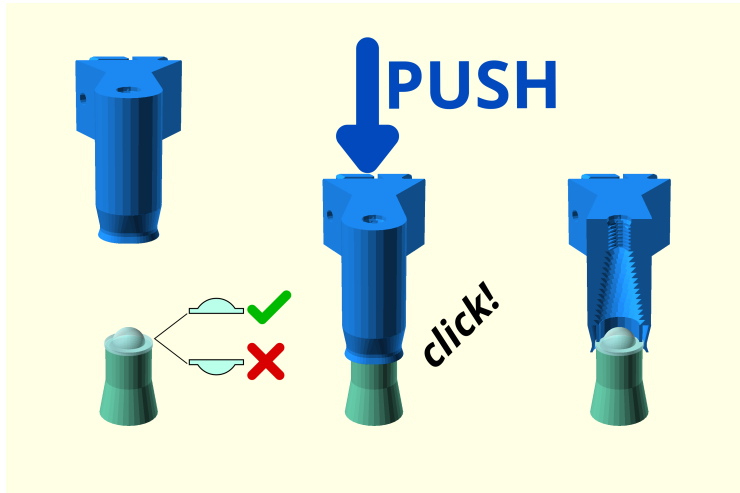
Automation helps!



Automation helps!



Automation helps!



Automation helps!

Assemble the actuators

There is one "actuator column" for each of the three axes of the OpenFlexure Microscope stage. These allow you to move the sample in X and Y, or focus the microscope by moving in Z.

For this section you will need:

Printed Parts

- 3 [feet](#) - Each actuator has its own labelled foot.
- 3 [large gears](#)

Printed Tools

- 1 [band tool](#)
- 1 [band tool cover](#)
- 1 [nut tool](#)

Sub-Assemblies

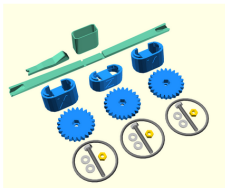
- 1 [prepared main body](#)

Consumables

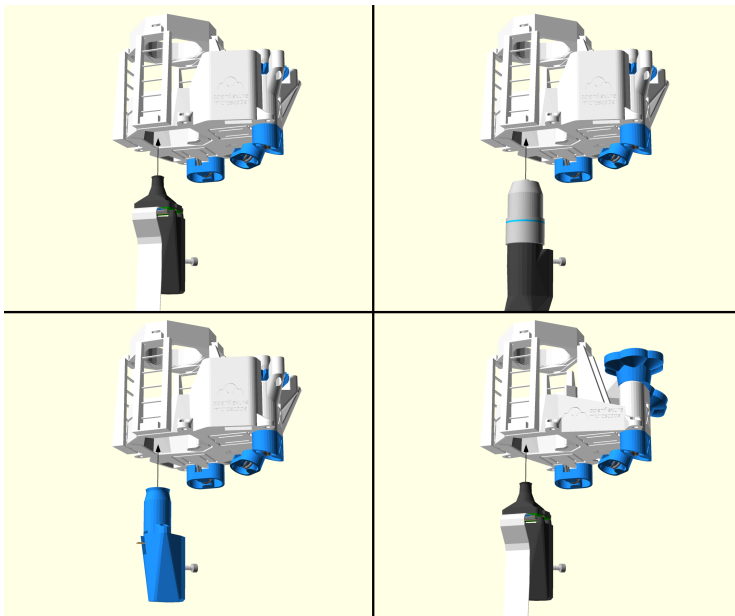
- 3 drops of [light oil](#) - Don't skip this or you will damage the screws

Mechanical Components

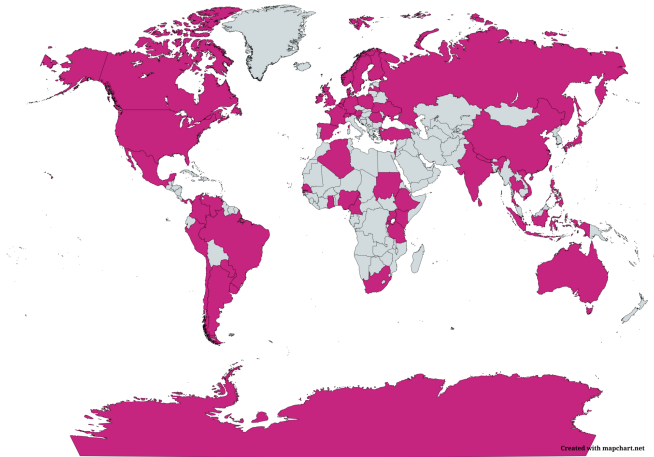
- 3 [M3 brass nut](#)
- 6 [M3 stainless steel washers](#)
- 3 [M3x25mm stainless steel hex bolt](#)
- 3 [Viton O-ring \(30mmx2mm\)](#) - "Viton band"



Automation helps!



Clear instructions allow replication and modification



Clear instructions allow replication and modification

METHOD ARTICLE

Adapting the 3D-printed Openflexure microscope enables computational super-resolution imaging [version 1; peer review: 2 approved]

Stephen D. Grant , Gemma S. Cairns , Jordan Wistuba, Brian R. Patton 

Department of Physics and SUPA, University of Strathclyde, Glasgow, UK

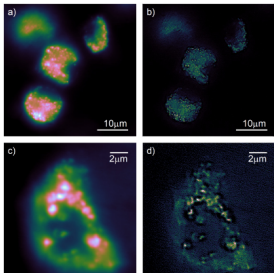


Figure 3. Fluorescence imaging of 90 nm nanodiamond in monocyte-derived macrophages. The nanodiamonds



Optical sectioning robotic microscopy for everyone: the structured illumination microscope with the OpenFlexure stages

TATSUNOSUKE MATSUI  AND DAIGO FUJIWARA

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1577 Kawasunehi, Tsu, Mie 514-8507, Japan
*matsui@elec.ee.mie-u.ac.jp

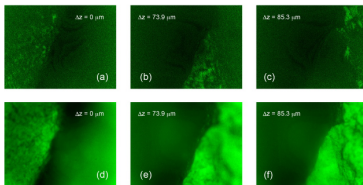
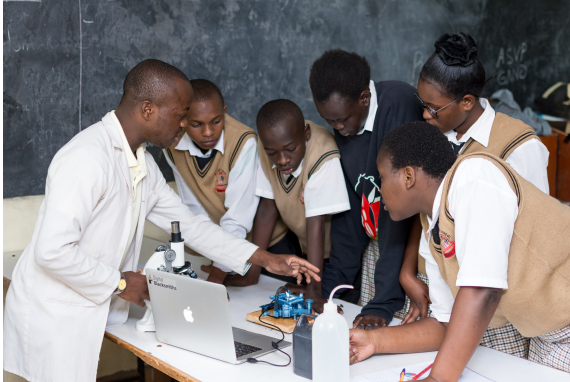


Fig. 4. (a)–(c) Optically sectioned and (d)–(f) conventional images obtained from corresponding images shown in Figs. 3(d)–3(f) by post-processing with Eqs. (1) and (2), respectively. These are at different axial positions of (a,d) $\Delta z = 0 \mu\text{m}$, (b,e) $\Delta z = 73.9 \mu\text{m}$, (c,f) $\Delta z = 85.3 \mu\text{m}$, where the axial position of $\Delta z = 0$ is at the plateau ground on the coin and a positive increase in Δz corresponds to going up to the hill of the numerical character of “0”. Scale bar 50 μm .

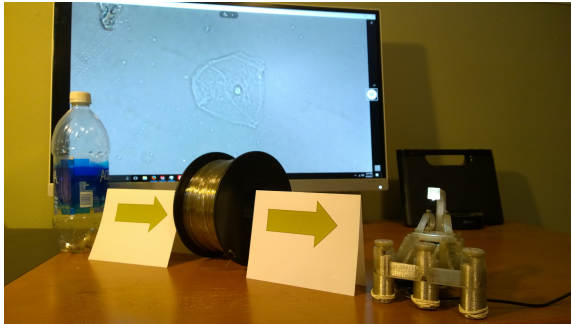
Clear instructions allow replication and modification



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Over to Joe

So, what does
this look like in
practice?











Quiz time!













from anywhere with how the tissue is processed,



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**OpenFlexure Voice Control**

Project ID: 28253641

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General

Applications

- OpenAFM - Atomic Force Microscope
- Create a resin micrometer 2D/3D printer

Y a t-il des français pour m'aider?

General

We're looking at making a bunch of openflexure microscopes for our microscopy students to take home with them so they can do lab work during Covid-19. We found an amazing deal on 13mm

Request Help

Contributions

Site Feedback

- Which configuration for dark field blood

- OCM of Logitech C370 - Hacking

- New forum Section for New Builds

- Test links on the site

Re: can I send the OpenFlexure to Space?**DIY soil microscopy workshop**

General

Openflexure for knife sharpening

General

Machine Learning

OpenFlexureCon 2022

Announcements

OpenFlexureCon 2022

- OpenFlexureCon 2022
- Unconference Session 1: Supply Chains
- Unconference Session 2: Funding &

Build a motorized telescope with the same hardware?

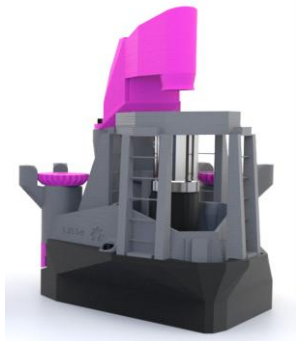
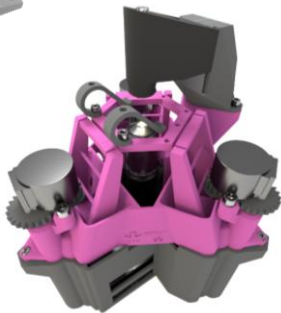
General

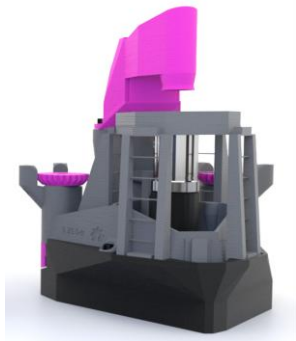
- v7.0.0-beta1

- Scaling up metallurgical builds and friendly hello

- Where are you? (OCM location survey)

**OpenFlexure Voice Control**Project ID: 28253641 







Live stitching preview

View



Navigate



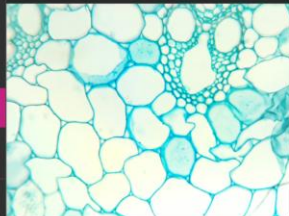
Background...



Slide scan



Scan list



[1.013402 -0.029747]
You don't need to update the width
Stitching complete

CLOSE

DOWNLOAD ZIP



Settings



Logging



About

Scan ID: scan_0019

