MIDLANDS
OPEN BIOIMAGING

In partnership:

UNIVERSITY OF BIRMINGHAM
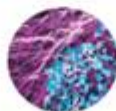
UNIVERSITY OF LEICESTER

University of Nottingham
UK | CHINA | MALAYSIA

WARWICK
THE UNIVERSITY OF WARWICK

MIDLANDS INNOVATION

COMPARE
CENTRE OF MEMBRANE PROTEINS AND RECEPTORS

https://midlandsinnovation.org.uk/midlands-open-bioimaging

Tim Self, University of Nottingham

- ***Who we are***

- Universities of Birmingham, Leicester, Nottingham and Warwick

- Midlands Innovation group representing all universities in Midlands

- COMPARE- joint initiative between Universities of Birmingham and Nottingham

- ***Idea for the pilot:***

'Develop a joined up asset and test innovative solutions to enable remote training and access to advanced microscopy'

- *BBSRC Strategic review of Bioimaging recognised that advanced Bd imaging is now the dominant form of analysis of molecules, cells and tissues across Life Sciences*

The motivation: training

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- **How is instrument teaching and training customarily performed?**
1. Theory taught through formal talks
2. Instrument training follows on a 1:1 or small group basis
3. Trained user works independently with input from core facility staff when required
4. In person trouble shooting by core staff

Then came the global pandemic

We had to adapt quickly and use our ingenuity to deliver 1-4 above

- *Teams & webcams*
- *Instructional videos*
- *Instruction from the microscope room doorway*
- *And even the use of a very long pointer*

We learned a lot about what worked, what didn't and what was not possible

The motivation: access

- It was clear that high end imaging could be undertaken within the restrictions of covid

- But, what could we do better?

- Could we be more ambitious?

- Could we extend access to our instruments to Midlands Innovation (MI) group and beyond?

- *How to make our research infrastructure more resilient?*

- *Democratise training and access to advanced technology (e.g. advanced imaging)*

- *Look at ways to open access to instrumentation for users who do not have these facilities*

- **Idea: develop and implement innovative solutions for remote training and remote access**
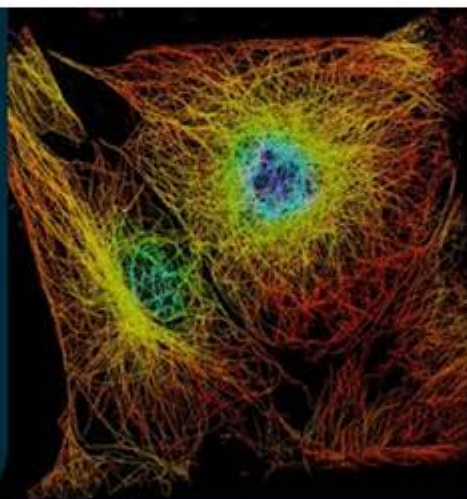
Our funding strategy

- Initial discussions between Helen Turner for Midlands Innovation (MI) and BBSRC

- Opportunity to submit joint proposal to establish MOB

- £1.1M "capital" funding by the BBSRC

- Resources to:
  - Upgrade equipment, software and IT infrastructure at 4 Institutions
  - Build new experimental system for fully automated advanced microscopy (UoB)
  - Support and promote remote training and access
  - Identify challenges and opportunities for future development

March 2022 official launch

Fast 4D microscope

System Requirements

Easy to use & High throughput

Wide range of applications

    2D or 3D cell cultures, tissue sections or small model organisms
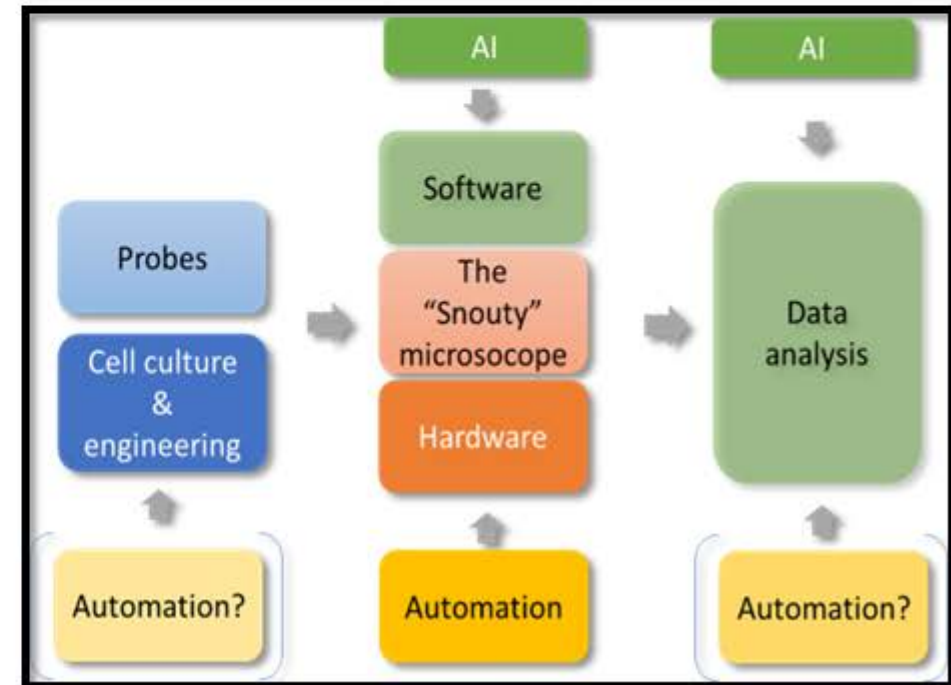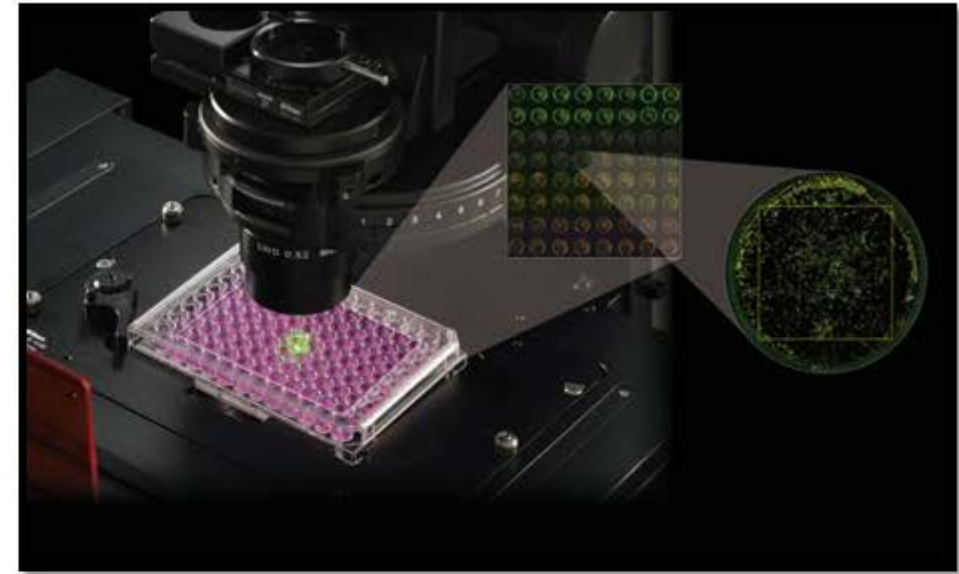
Potential for AI & Automation

Accessible advanced microscopy

    Full automation for remote access

    Deliver high spatiotemporal resolution

    Low toxicity volumetric timelapse imaging

The "Snouty" imaging system

- Single-objective light-sheet (SOL)

- 4 lasers (405, 488, 560, 638 nm)

- 4+1 cameras (95% QE, 500 fps!)

- 60x Silicone objective, NA 1.3

- FOV ~320 um2, DOF ~10um

- Spatial resolution ~350nm

- Temporal resolution < 2.2 s/volume (360X360X10 um3)

- LabVIEW control
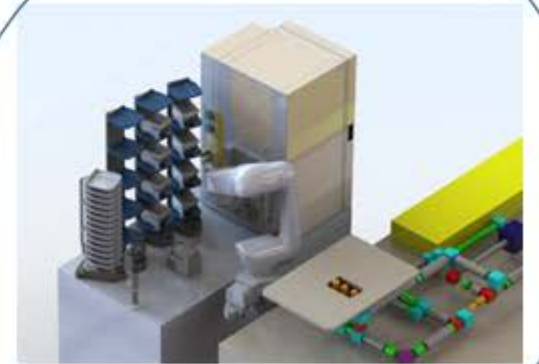
- Fully automated for standard multi-well plates

High NA light-sheet microscope

High NA single-objective light-sheet

Alfred Millett-Sikking[1*], Kevin M. Dean[2], Reto Fiolka[2,3], Amir Fardad[4], Lachlan Whitehead[5,6] and Andrew G. York[1†]

Advanced Imaging + AI

HCI + Automation

Towards intelligent automation

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- Innovative light-sheet design (not yet available commercially)
- Ideal for high-content 4D imaging in multiwell plates
- High speed AND resolution
- Full integration with automated incubation, robotics and liquid handling
- AI-driven cell selection and automated acquisition
- Capable of generating large datasets for machine learning
- Applications: Discovery science, drug screenings, etc.
- Potential for commercialization

Towards intelligent automation

@Jonas_Euchner

Progress to date

- Experimental system for fully automated advanced microscopy has been built at Birmingham and is undergoing initiation testing

- Upgrades to existing microscopes and purchase of upright LM, interactive screen, webcams, Teamviewer at Leicester, Nottingham, Warwick

- Joint initiatives for image analysis training, co-ordinating training across 4 core facilities

- Joint seminar series (remote and in-person)

- Remote access and control of instrumentation working well e.g. commercial
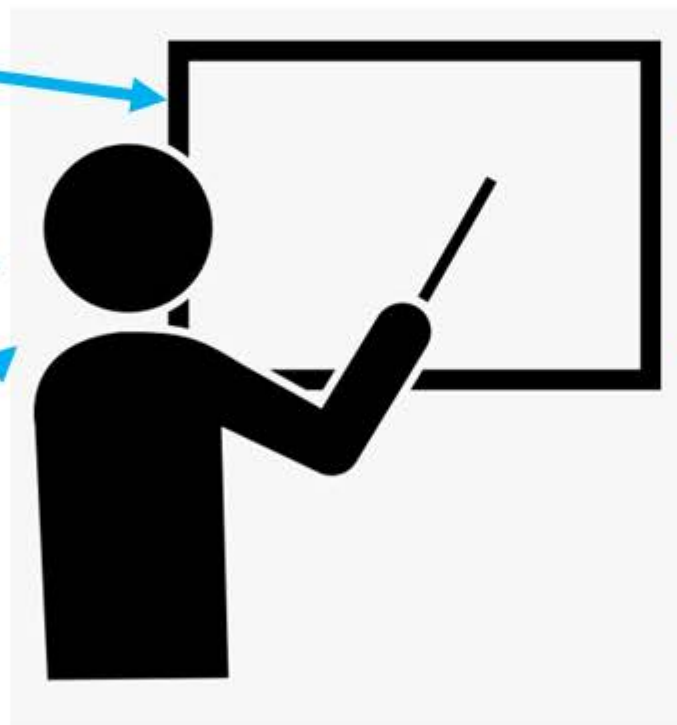
Teaching and training

Manufacturer specialist

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Live stream
UoN &
externally

Image analysis teaching:
UoN & externally
Small to large group

Interactive screens

Small to large group

Lessons learnt

- There are several lessons learnt from the project so far, which could also be extended to other areas

- Great opportunities for joint initiatives in equipment/technology sharing, and joint strategic funding bids in this area. MI ideal catalyser

- Project involved complex coordination across 4 Institutions, multiple teams (design and planning, logistics/estates, purchasing, accounting, etc.) in a short time (Award 01/10/21, Spend by 21/03/22). This and similar projects would benefit significantly from involvement of key liaison staff

Lessons learnt

- Current institutional IT policies designed to maximize security, but lack sufficient flexibility to fully implement remote access and data sharing:

    - E.g. TeamViewer, widely used remote desktop software, could not be adopted as a general solution because some of the Universities IT teams have been uncomfortable with it.
    - The idea of users from outside universities accessing computers/equipment have caused some concerns for IT teams.
    - We have started to have an all-partnership dialogue between IT and the Imaging Facilities to explore how we can make things better in the future. The next step in this dialogue is to produce for IT services a set of usage scenarios so that we can help them to better understand what success looks like.

- Justified/unjustified Individual/institutional concerns about privacy ("Some users are covering cameras for fear of being observed"; "IT refused to purchase our highly needed webcams because they are made in China")

Looking to the future

- Further consolidate close cooperation between the Microscopy Facilities of our 4 Institutions and MI (Equipment sharing, training, common policies, etc.)

- Expand to other MI Institutions and other potential partner in our region

- Continue building the MOB user community

- Find solutions to support new users who would benefit from the MOB infrastructure/expertise (e.g. pump priming)

- Collect user experience and use it to further develop our strategy

- Explore opportunities for commercialisation

- Plan what comes next and explore opportunities for additional external funding (e.g. BBSRC)

- Share learning with the wider MI infrastructure community so that it can be applied to other areas

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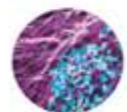
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