

Towards community standards in Adaptive Feedback Microscopy

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What is Smart Microscopy?

Smart or Adaptive Feedback Microscopy aims at connecting bioimage analysis (and other algorithms) with fully motorized and computer-controlled microscopes to generate automated and adaptive imaging workflows. This strategy can also be used to manage changes in the sample's environment (e.g. fluidic devices) and directly link the microscope to image data management systems.

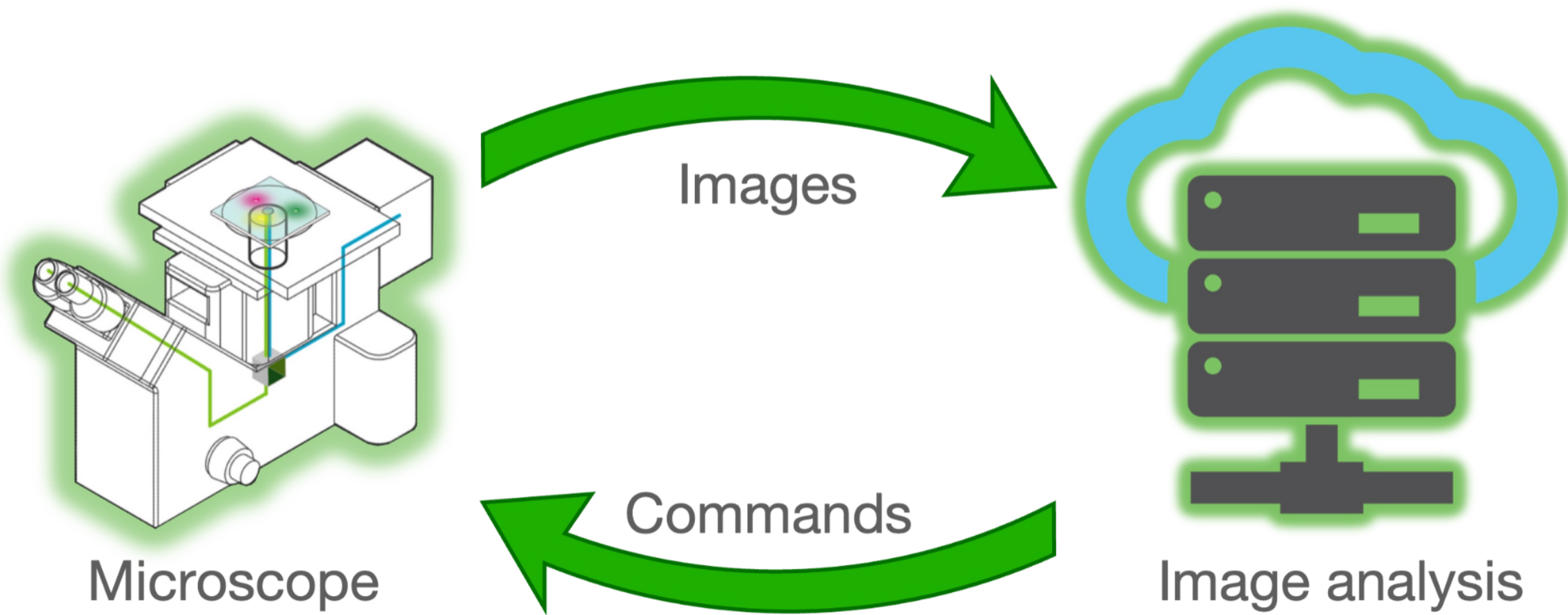


What we aim to achieve...

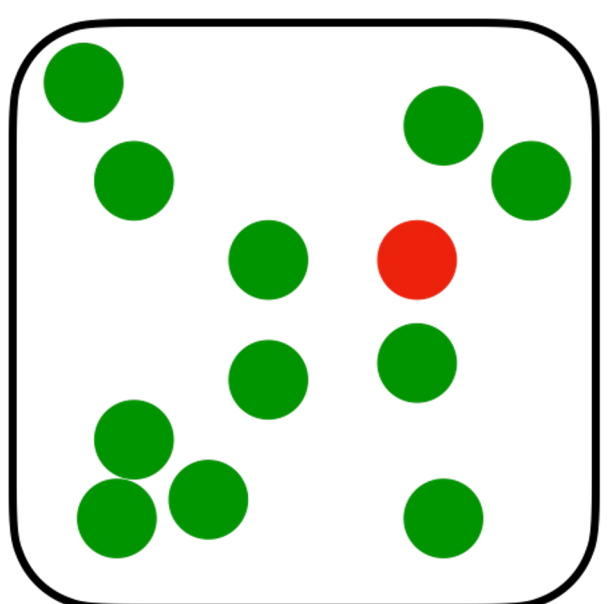
The automation of end-to-end imaging workflows is not only an endeavour of academic groups, the microscopy industry at large is pushing toward microscopy automation. While there are several software solutions for microscopy control that can be used to implement smart-microscopy workflows, there is no reference specification on what functionalities are needed, or how these workflows could be implemented. To facilitate the development of smart-microscopy applications, and enable their execution across imaging-systems with similar modalities, we, the **Smart Microscopy Working Group**, are working to establish such a standard specification and to put forth desired workflows, then in dialog we find functionality requirements, reach common terminologies, and share these with the community for feedback and improvement. The working group is composed of participants from both academia and industry, meeting regularly online with the support of the Euro-BioImaging Industry Board.

Workflow and use cases

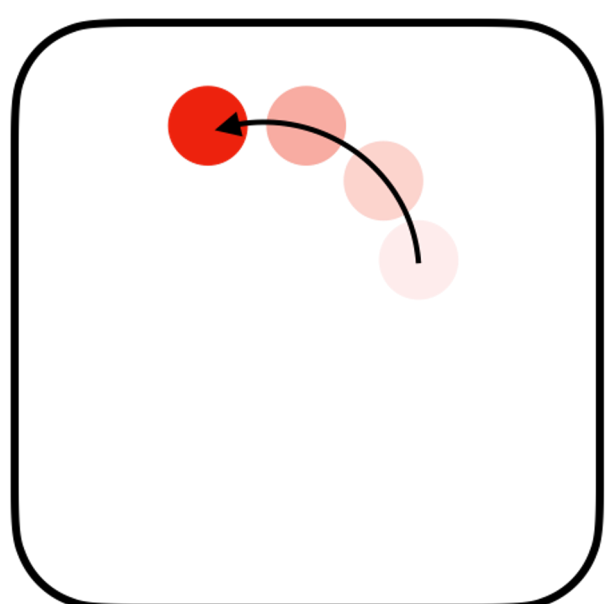
The characteristic feedback loop, performing feedback microscopy:



Three common use cases that are greatly facilitated by smart microscopy schemes such as (adaptive) feedback microscopy:



TARGETED IMAGING OF IDENTIFIED OBJECTS AND TRANSIENT EVENTS



FIELD-OF-VIEW REPOSITIONING (TRACKING, DRIFT CORRECTION)

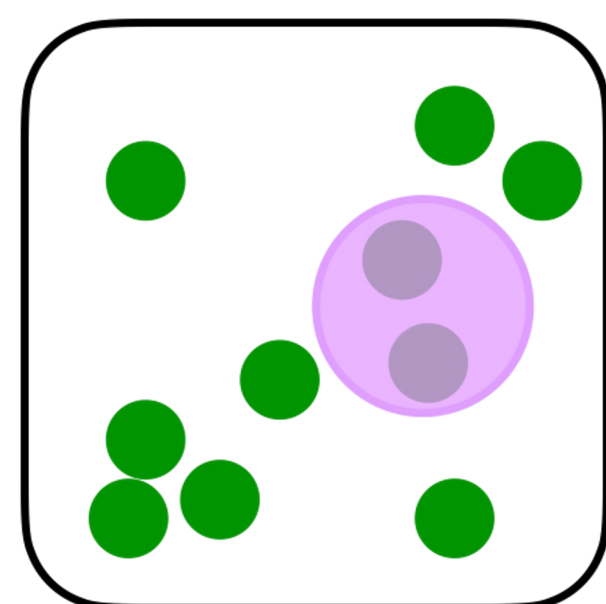
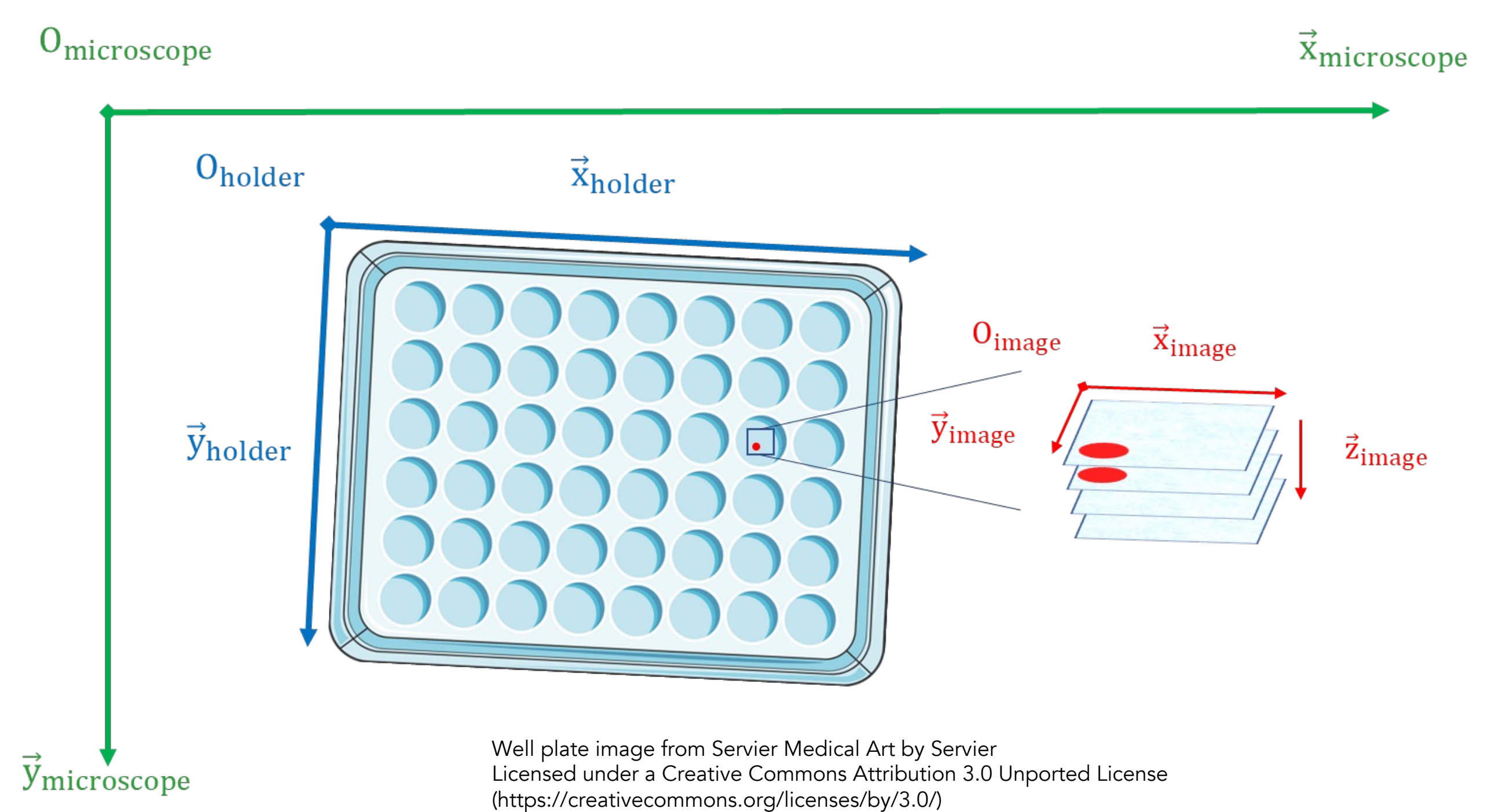


PHOTO-MANIPULATION (FRAP, PHOTOCONVERSION, ABLATION)

Coordinate system



Well plate image from Servier Medical Art by Servier Licensed under a Creative Commons Attribution 3.0 Unported License (<https://creativecommons.org/licenses/by/3.0/>)

To facilitate targeted imaging across imaging systems, we propose the following coordinates systems for the declaration of sample positions :

- a reference space aligned with the imaging system, used to express the directions of the microscope components, e.g. stages, objectives (green)
- a reference space aligned with the sample holder (blue)
- the image-space with pixel coordinates (red)

These spaces are related by geometric transformations (translation, rotation, scale, shear) which can be adapted to the imaging system used.

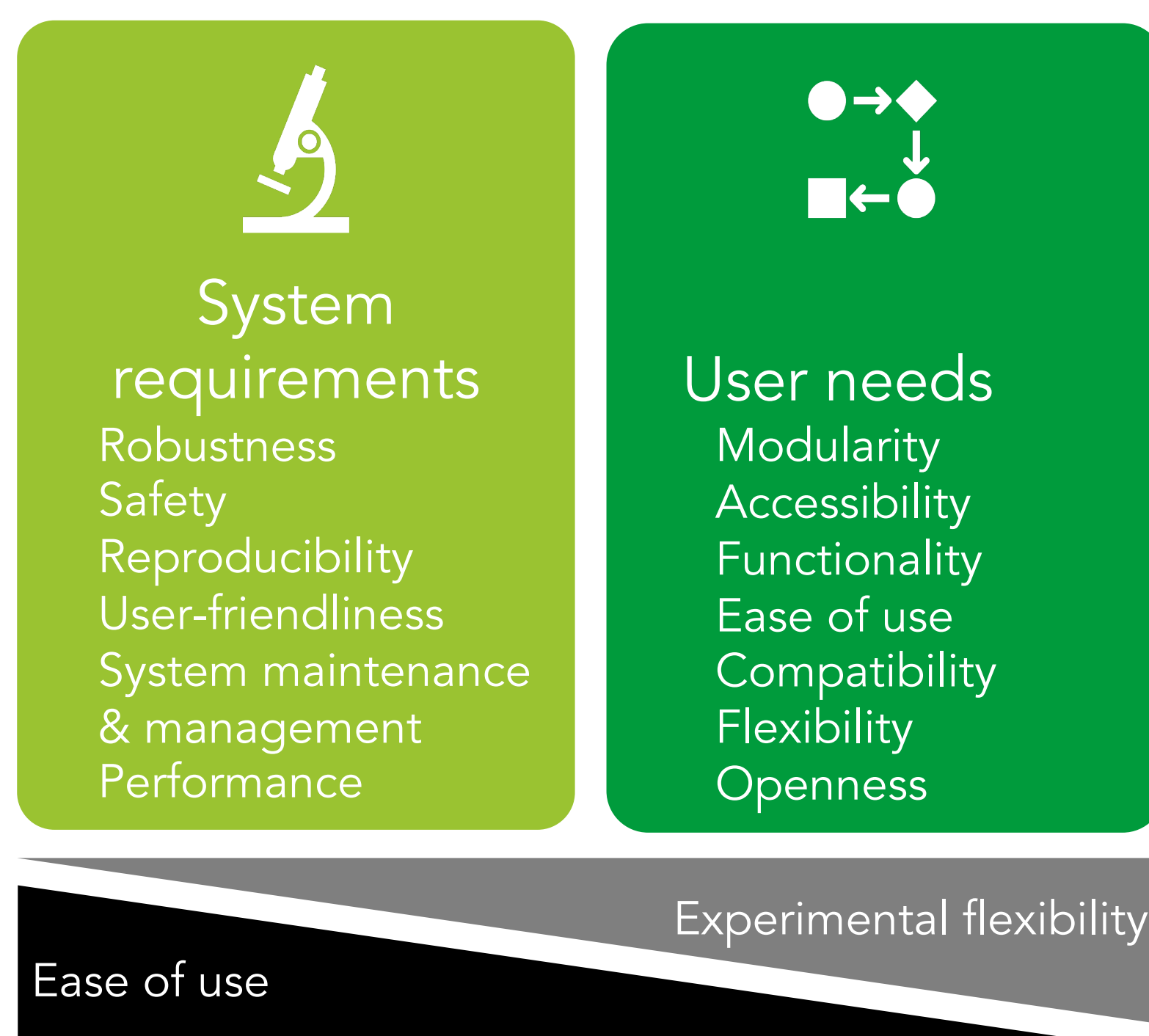
The need for academia-industry collaboration

To generate a common ontology, standardize workflow modules and ultimately increase adoption of adaptive feedback microscopy, we need to bring together manufacturers, developers and end users to better understand

- microscopists' and researchers' needs
- system requirements and limitations
- user experience optimization

The usefulness of such community dialogue is exemplified by initiatives such as Quarep-LiMi¹, where several cross-organizational working groups have been established to drive standards in Light Microscopy, or the Euro-BioImaging Industry Board promoting the exchange between expert users at imaging facilities and companies.

Our goal is to jointly define a list of basic universal requirements and minimal, modular smart microscopy workflows that can be implemented in equipment from different vendors.



¹ Boehm et al., 2021, <https://doi.org/10.1038/s41592-021-01162-y>
² <https://eurobioimaging-industryboard.com/>

How to get involved



We are currently looking for interested users and developers (no matter your level of experience) from both academia and industry to

- Join our working group or
- Participate in the community discussion



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