Towards Community Standards in Adaptive Feedback Microscopy

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Abstract

Much effort has been made over the last decade to connect bioimage analysis (used to, e.g., detect target cells in microscopy images) with fully motorised and computer-controlled microscopes to generate automated and adaptive imaging workflows, referred to as smart microscopy or adaptive feedback microscopy. Moreover, this strategy does not only allow to control the microscopes, smart microscopy has been used to handle complex changes in the sample's environment, in applications such as, immunohistochemistry, sequential super-resolution microscopy, and fluorescence multiplexing imaging, by controlling complex liquid handling equipment together with adaptive feedback to the microscope.

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, leveraging on image analysis and artificial intelligence. This way the industry is trying to transform and improve existing workflows, minimise human error, increase productivity and stability, optimise usability, and open new opportunities. Clearly, based on those trends and the motivation behind them, the architecture of modern imaging systems including control and analysis software must be designed with respect to the needs of feedback microscopy, which creates a challenge for commercial manufactures: to find the trade-off between full flexibility, stability, and the effort to maintain and manage such systems. Enabling these workflows on commercial equipment requires either i) corresponding modules becoming available in the vendor's software or ii) exposing the microscope’s control via programming interfaces from other (often open-source) programs. While the first approach has the advantage of easier configuration for standardised applications and less experienced users, the second approach opens even wider experimental possibilities.

To face the challenges of smart microscopy and increase the adoption of such workflows, the academic and commercial sector are teaming up with the support of the Euro-BioImaging Industry Board. We aim for researchers and core facility staff to put forth desired key workflows. The applications being discussed include, but are not limited to i) automated finding and imaging of target objects; ii) tracking moving objects and iii) adaptive photomanipulation experiments (e.g. FRAP, photoactivation, laser ablation, optogenetics, etc.). Then in dialogue with industry, we will define functionality requirements and reach a common terminology/ontology, which will be shared with the community for feedback and improvement.

Our goal is to generate smart microscopy workflows that can be implemented in equipment from different vendors with minimal overhead. In this poster we present our efforts and the team involved. We wish to get feedback from our microscopy colleagues and also call upon interested parties to join the group discussions. The outcome of our efforts will be shared with the community via a public repository and posts in the Image.sc forum.