

Open Research Case Study



Establishing Open Standards for Quality control and Reproducibility in Light Microscopy

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Introduction

Raising awareness of the importance of good characterisation of light microscopes is essential for experimenters and readers of published data so that they can understand the limitations of the conclusions that can be drawn from the images. Many custodians of light microscopes, as well as the scientists using the machines, are often unaware of the many factors affecting the final image produced on the system, or, importantly, how to check the image is within the expected tolerances of the microscope. We are actively involved in defining a set of open standards and tools that allow users to test their microscopes to ensure the systems are performing as expected. This work also includes educating microscope custodians and raising awareness of the issue, with the ultimate aim of improving trust and reproducibility in published data.

Research Context

Light microscopes are ubiquitous in research, and a large percentage of published papers in biological research include images or data obtained from light microscopes. Often, conclusions are drawn from these data that can only be made if the experimenter can also show the microscopes performance. Additionally, many researchers are unaware of what extra data should be published with the microscope images to allow others to reproduce the data reliably, and almost all Method sections written are lacking in essential information.

Open Practices Used

We were instrumental in establishing an international consortium of microscopists to address these problems. This consortium, 'Quality and Reproducibility in Light Microscopy' or QUAREP (<https://quarep.org/>) is completely open to all interested, and encourages involvement from academia, industry, publishers and Standards bodies. We are publishing open and accessible (cheap, generic) methods for users and manufacturers to implement, initially using protocols.io as an open platform. We provide free hands-on demonstrations of the methods and give tools for running some of the tests at conferences. All publication output are open source and freely available.

Benefits

The first major benefit of our work has been the increased awareness amongst the community of the need for Quality Control tests and good maintenance of light microscopes. This has been achieved through initial production of a White Paper (published in Nature Methods and Journal of Microscopy) defining the problems and our aims, of which we were instrumental in writing. We have followed this up with talks at conferences, including hosting a session on Quality Control at Microscience in 2023 and providing hands on demonstrations at the European Light Microscopy conference (ELMI) in 2023 and 2024.

Raising awareness with general microscope users has also been important, and we have done this with publication of recommended publication guidelines for light microscope images. Ladtly, we are slowly being successful in bringing microscope manufacturers to realise the need for such tools, and several are now providing these at the point of purchase and/or as after sales care. The benefits of standardised quality control are evident for all microscope users, all readers of the published data and any researchers wishing to reproduce the work published by others.

Barriers encountered

The major hurdle for us is that we are performing this work as volunteers, and it has been slow to raise enough awareness to allow us to be successful in gathering funds to support the work. We have obtained a small grant from the Medical Research Council, which has helped us provide admin and support for developing software tools. Since we lack direct funds, we have instead engaged with conference organisers and publishers to allow us access to venues and open publishing rights.

Lessons learned and Conclusions

Being international, the work has greatly benefitted from on-line meetings and in fact grew in strength so quickly in part due to COVID lockdown. We have realised that we're pushing against an open door: many people are in complete agreement that it should be improved, mostly for the simple reason of making science more trusted and reproducible. However, we are completely aware that to succeed, the tools we produce must be as simple and quick to use as possible- the largest barrier we see to uptake of Quality Control in light microscopy is the lack of time by those having to perform the tests. More work is required to define all the standards and their respective tests. Ultimately, we wish all publications with light microscope data in them to be able to directly link to data that shows the performance of the microscope used during the time period their work was undertaken, allowing readers to check the conclusions drawn and easily reproduce the work.