μMANAGER: OPEN SOURCE SOFTWARE FOR MICROSCOPE IMAGE ACQUISITION CONTROL

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Most advances in microscopy during the last half century have been possible only through electronic control of microscope components. Indeed, all types of current fluorescent microscopy in the life sciences rely heavily on sensors providing digital readout and computer control of peripheral devices making control software an integral and important part of the microscope system. Groups developing novel microscopy technologies either write their own code from scratch or use tools such as LabView, whereas the “consumers” of these novel technologies most often rely on dedicated commercial software packages such as MetaMorph, Nikon Elements, Zeiss Zen and others. The former set of tools provide great flexibility at the cost of development time, maintenance issues and difficulties in transferring to other hardware whereas the latter is hard/impossible to extend, often only operates with a small set of hardware devices and adds considerably to the system’s cost.

To remedy this situation and provide a microscope control environment useful for both developers and users, we started the open source software project μManager [1] in 2005. μManager has a straightforward user interface (it runs as a plugin to ImageJ, a widely used freely available image analysis application) including facilities for multi-dimensional acquisition, yet can be extended through scripts and plugins. Through such plugins we provide extra capabilities to our users such as the ability to interactively scan large areas of the sample through the “Slide Explorer”, and to execute super resolution techniques using the “Localization Microscopy” plugin.

The heart of the application is a device abstraction layer (called “Core”) that provides a uniform interface to higher layers of the software (which do not need to concern themselves with specifics of the hardware) and that has a pluggable interface to the devices. The μManager Core can be used from many different environments, including C++, Java, Python, and Matlab, providing a universal software toolbox for microscope component control. This software architecture allows anyone to write code supporting a new device and most device support in the μManager code base has been contributed by outside developers. More than 120 different devices are supported, including microscopes from all major companies, scientific grade cameras from more than 25 vendors, etc.. μManager is used at more than 3000 microscopes world-wide and can be freely download from http://micro-manager.org. Development is supported by grant 2R01EB007187-05A1 from the NIBIB.