STED in a Shoebox

Ultra-Compact Microscopes with Unprecedented User-Friendliness

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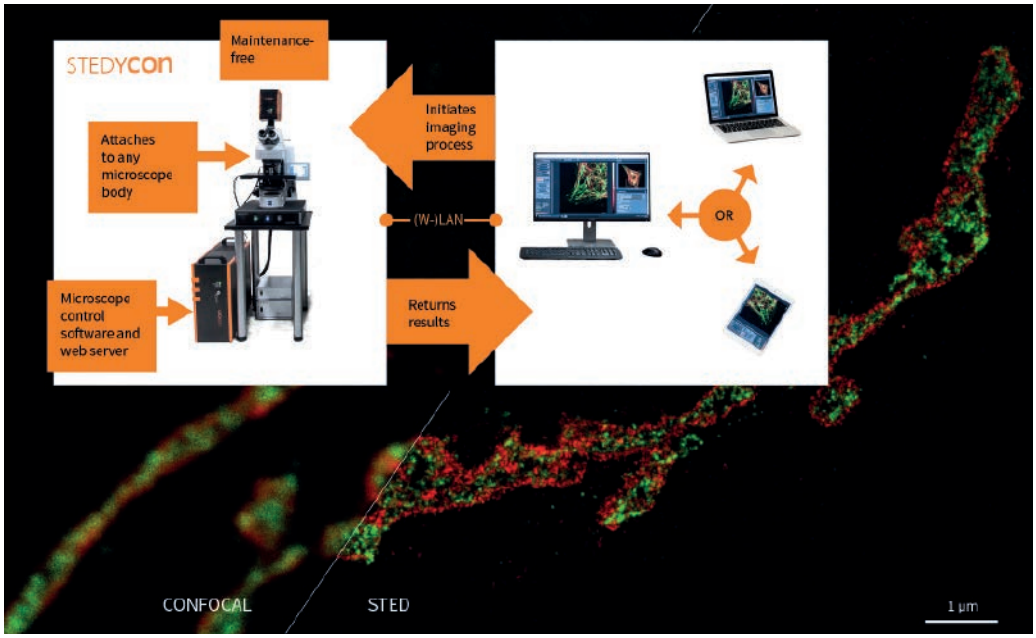

Two proteins (GM130, Giantin) in the Golgi apparatus were immunolabelled using Abberior STAR580 and STAR635P. Shown is raw data. Insets: A maintenance-free add-on nanoscope that can be operated using e.g. PC, laptop or tablet.

In the last years, STED microscopy came to be a powerful method and contributed to various accomplishments in the life sciences. Nevertheless, high-end microscopes are still a privilege of well-funded institutions. Several issues have to be addressed in order to change this: first, the system must allow to take a super-resolution image essentially at first sight, without extensive training. Second, in the long run, the user wants to be efficient, i.e. a measurement campaign should not be hampered by diminishing performance over time or by repeated alignment. The system should be highly reliable and as simple as possible, and it should be affordable. With this as our motivation, we developed the Stedycon, a shoebox-sized solution for STED and confocal microscopy that is easy to learn, efficient to use, maintenance-free, and affordable. It can be installed within minutes on practically any recent microscope body by fixing it to the camera mount, enabling everyone to take advantage of cutting-edge super-resolution microscopy.

EasySTED

Several innovations were driven forward to make this possible. First, easySTED ensures that all beams are aligned by design. This is different from standard microscopes, where beams gradually separate from each other due to thermal drift. In our new nanoscope, the excitation and STED beams are fed through the same fiber and therefore they cannot physically go out of alignment in the first place, making calibration procedures and service visits a thing of the past.

QUAD-Scanner

Second, the design goal of a microscope that can be attached to a wide range of bodies requires means to adapt beam alignment to whatever optics follows in the host. Standard scanners rely on scan lenses that are expensive and specific to vendor and model of the microscope body. With our new instrument, a QUAD-Scanner creates the desired flexibility. Two mirrors per scan axis offer the necessary degrees of freedom to position the beam freely in all three directions. This way, the scanner can be adapted to different microscope bodies simply by changing software parameters.

Embedded System

Finally, we have devised a browser-based multi-user approach for the software user interface by embedding all low-level routines and a webserver in the nanoscope. Users can log on over the network with any type of PC, tablet or even a smartphone and run a web application in their browser for communicating with the system. This means, they can control it from their own laptop and their personal settings are right at hand and the data they produce is automatically saved to their computer. Or, one can use a tablet in place and later log on to the instrument from the office and remotely pull data.

Summary

The standard methods of microscopy face increasing competition from new disruptive super-resolution technologies as many scientists simply have to make use of these techniques in order to generate seminal data. The speed of this replacement will pick up with the Stedycon that proves that top-notch super-resolution can be provided in a robust, affordable, and easy-to-use way.

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