Sensor-less adaptive optics in an aperture correlation confocal microscope

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The laser-free spinning disk confocal microscope using aperture correlation is a powerful tool for observation inside biological specimens, enabling optical sectioning at high temporal resolution. However, observation deep inside thick specimens suffers from aberration due to the spatial variations of refractive index of the specimen itself [1].

Here we implemented sensorless adaptive optics (AO) system [2] using a deformable mirror (DM) into commercial spinning disk laser-free confocal microscope module (Clarity, Aurox Ltd., UK). Normally, Clarity is attached directly onto the side port of microscope body. In our setup, on the other hand, telescope systems were inserted between Clarity and microscope body, in order to create an intermediate pupil plane and place the DM. To control the system, we used Python Cockpit, Microscope and microscope-aotools [3].

To test our setup, we performed aberration correction for fluorescence imaging of *Drosophila melanogaster* larval neuro muscular junction (NMJ) – muscles 6 & 7, segment 3, with their Nuclei and synapse labelled respectively by DAPI and Alexa Fluor™ 488. Fig.1 shows the obtained images with and without aberration correction. The images with correction provided higher contrast, revealed finer structure and made the synapses visible that were barely visible without correction.

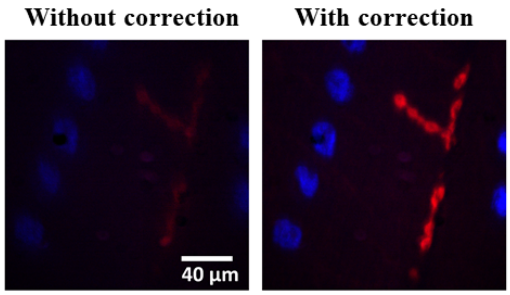

Fig.1 Fluorescence image of NMJ, with nuclei (blue) and the synapse (red). An oil-immersion objective lens (Olympus, 1.4NA, 60x) was used for observation.

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