Motion Artefact Detection in Structured Illumination Microscopy

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Structured illumination microscopy (SIM) is a high-resolution fluorescence microscopy technique, which overcomes the Abbe diffraction limit by a factor of two and also provides optical sectioning [1]. The necessary SIM reconstruction algorithm combines several raw images, each acquired with a different sinusoidal shaped excitation pattern, into one high-resolution image. The algorithm needs the assumption of a rigid specimen. However, in practice, living cells might move or reshape, so that the reconstruction will produce unpredictable and sometimes misleading artefacts. We developed an algorithm that is able to detect and locate movement out of the SIM raw data and marks them in the final image. Our technique exploits redundancies in the raw data to determined sample movement without the need of additional images. In order to distinguish between the effects of movement and ordinary imaging noise, we estimate the noise in each raw image and propagate it through the image processing. [2].

We demonstrated our algorithm successfully on moving cells (see Fig. 1). The SIM image on the left shows a moving chloroplast (top) and a fixed stoma cell (bottom). The heatmap on the right reveals the movement of the chloroplast and some dim particles [2]. Because of its robust behaviour and its direct applicability to the standard 3D-SIM processing, our algorithm is a mandatory tool for any SIM microscope and reconstruction.

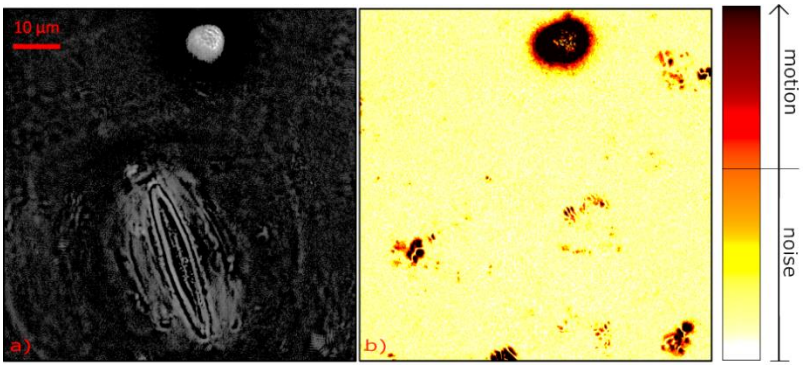

Figure 1: a) SIM-Image of living cells b) corresponding motion map

References

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