HIGH-SPEED ENHANCED RESOLUTION SIM IMAGING FOR REAL-TIME STUDY OF MITOCHONDRIAL DYNAMICS

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Mitochondria are highly dynamic structures that serve as a powerhouse to the cell. They constantly change shape, fuse and divide, and are remodelled even in their inner nanostructure[1]. Studies strongly suggest that the inner membrane topology is a regulated property of the mitochondria and that physiological factors determine this membrane's topology and, conversely, that the inner membrane shape influences mitochondrial functions. These factors are crucial, and defects lead to disorders like neurodegenerative diseases, cancer, ageing etc. Super-resolution techniques have made possible their observation at a few nm-scale but only in fixed samples. Dynamic studies in live cells require fast and high-resolution imaging microscopy such as structured illumination microscopy (SIM). Furthermore, our original SIM approach allows to achieve optically sectioned high-resolution[2] imaging inside a cell with an enhanced video rate thanks to an inverse problem-based reconstruction algorithm, which only requires four acquired images (instead of 9) [3]. Cells physiological state is controlled by using a photo-sensitive molecule which, when activated, induces a controlled-stress on the cell. Hence, in this study we demonstrate a high-speed SIM imaging technique of the inner mitochondrial dynamics of living HeLa cells under oxidative stress. Our goal is to decipher real-time mitochondrial dynamics at the nano-scale and to give new insights into the functional nature of their nanostructure.

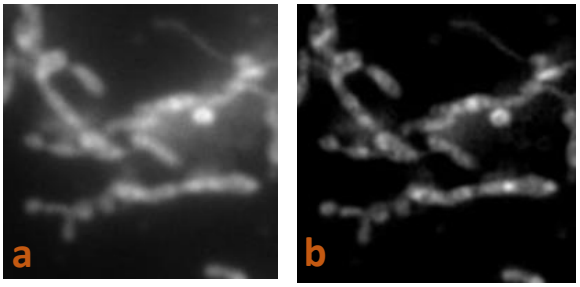

Figure 1: HeLa cells imaged using our SIM set-up (a) Raw SIM image (b) Reconstructed SIM image

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