Dynamic SIM for high-speed imaging and optical sectioning in living samples

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Live cell studies at the molecular level strongly depend on imaging performances. Structured illumination microscopy (SIM) brings a significant gain, as an increase of a factor 2 in lateral resolution allows observation of many new phenomena. However its current use for biological applications still requires major technical improvements in order to combine lateral super resolution with video rate imaging and optical sectioning of live samples.

We will present a structured illuminated microscope by fringe projection together with an original and efficient reconstruction algorithm (Orieux 2011) that only requires 4 acquired images (instead of 9) to obtain a super-resolution one. Using this improvement and a sliding recombination of the raw images, it is possible to create super-resolution movies with a quarter of the information renewed in each reconstructed image. This unique approach allows realizing dynamic SIM movies of live samples with an increased temporal resolution compared to other structured illuminated microscopes.

In order to observe phenomena several micrometers deep into a cell, we combine SIM with optical sectioning techniques. It is indeed possible to perform super-resolution with optical sectioning using 7 images (versus 15 for other SIMs) by allowing the zero order to interfere with the ±1 orders.

We will present high spatio-temporal resolution observations of molecular mechanisms underlying transport intermediates biogenesis.