The application of aberration corrections on tracking of HER receptors

Valentina Lo Schiavo, Benjamin C. Coles, Laura C. Zanetti-Domigues, Stephen E.D. Webb, Marisa L. Martin-Fernandez

Science and Technology Facilities Council, Research Complex at Harwell, Rutherford Appleton Laboratory, Harwell Campus, Oxfordshire, OX11 0FA
E-mail: valentina.lo-schiavo@stfc.ac.uk

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For centuries light microscopy has been widely used in biology to reveal and image cellular and molecular structures. Despite its advantages, standard fluorescence microscopy is limited by the diffraction limit which doesn’t allow scientists to resolve nanometric structures at very high resolution. In the last years, a number of super-resolution methods have been developed to bypass the diffraction limit in different ways. These include STED[1], SIM[2], PALM and STORM. With these methods a lateral resolution of 10-50 nm and axial resolution of 20-100 nm can be reached.

Though, the achievement of nanometric resolution is dependent on a wide range of factors. A very important one is the ability to minimize the aberrations that can arise from the microscope’s components and detectors, the discrepancy in the refractive index between the objective and the immersion medium, and the biological sample itself (drift, background).

In this work, the displacement of human epidermal growth factor receptors (HER) inside cell membranes is tracked and correct for aberrations.

HER receptors constitute a family of four cell surface receptors involved in transmission of signals controlling normal cell growth and differentiation. HER family receptors are located on the surface of the cell. Each receptor has an extracellular and intracellular domain: the extracellular domain may bind ligands and the intracellular tyrosine kinase domain activates downstream signalling pathways. The key role of the HER family receptors in cancer has been also widely acknowledged. Indeed, when HER signalling pathways are inappropriately activated, growth and spread of cancer cells may result.

Here fluorescently labelled HER receptors are followed inside a membrane and their tracking is then optimised by using an adaptive optics device (MicAO 3DSR, Imagine Optic) which is able to correct for aberrations with extreme precision. The results are a promising starting point for carrying out further successful imaging of HER family receptors. Indeed, the adaptive optics device can be used together with super resolution techniques such as STORM and PALM to obtain 3D high resolved aberration-free images.