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Refractive Index Matching for in vivo Light-Sheet Microscopy

The emergence of Selective Plane Illumination Microscopy (SPIM) about a decade ago enabled scientists to study the development of whole embryos (e.g. fruit fly, zebrafish, mouse) with unmatched spatiotemporal resolution and low phototoxicity. Yet, true in toto recordings of only few model organisms have been realized thus far. As any light microscopy technique, SPIM suffers from optical aberrations, light absorption and scattering – especially when imaging large samples, e.g. embryos. Our goal is to push further the current depth limitations in light-sheet microscopy and enable the study of in toto organogenesis and development in frequently used model organisms. To achieve this, it is crucial to minimize aberrations induced by the optical setup, the interface between sample and mounting medium, and the sample itself.
In this work, we present our results of refractive index tuning in light-sheet microscopy to minimize aberrations arising from the refractive index mismatch between sample and mounting medium. We show that by adjusting the refractive index in light-sheet microscopy one can reduce aberrations and restore image quality in deep tissue layers of mouse and Medaka embryos, as well as in the root tip of Arabidopsis. Further, we discuss our results of matching the refractive index to specimens with different optical properties as the fruit fly embryo.

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Terms and Conditions

Yes

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