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Three-dimensional optical tomography of biomedical tissues

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In the field of optical microscopy, the size range of biological and medical samples of interest varies from single biomolecules (nanometer scale) to whole animal organs (centimeter scale). Since this size range spans across 7 orders of magnitude, different optical tools are needed to analyze such samples across these scales. The mesoscopic size range is concerned with the larger structure of samples up to several centimeters. For such large samples, the penetration depth of optical microscopy is limited by the interaction of light with tissue causing absorption and scattering. The amount of scattering depends on the thickness and the transparency of the sample. The larger the sample, the lower is the best achievable resolution. With the use of optical projection tomography (OPT) it is possible to image and reconstruct the internal three-dimensional structures of such large samples. For example entire intact murine organs are visualized without the need for physically cutting the tissue. The sample must, however, be cleared before imaging to improve the penetration depth of the visible light and fully resolve the internal structure. We are currently working on improving the whole mount staining process using indirect antibody labelling for different types of biological samples, i.e. mouse organs, mouse embryos and human nasal polyps. Optical clearing is performed using the organic solvents benzoic acid and benzyl benzoate (BABB) and we are characterising the effect of pre-bleaching the tissue with H2O2. The OPT setup is combined with a mesoscopic light-sheet microscope to compare the resulting reconstructed images and the resolution of both techniques based on the same sample. OPT is used to characterize and measure the internal structure, i.e. the three-dimensional distribution of blood vessels and calculating i.e. the microscopic vessel density. Our current status of improving the imaging conditions, sample preparation, and the optical setup will be detailed.

Category

Other

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