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Multi-sample SPIM image acquisition, processing and analysis of embryonic zebrafish vasculature

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To quantitatively understand biological processes that occur over long time periods, it is desirable to image multiple samples simultaneously, and automatically process and analyze the resulting datasets. Here, we present a comprehensive and dedicated multi-sample image acquisition and processing workflow using selective plane illumination microscopy (SPIM) to image several embryos up to 4 days and demonstrate its value for understanding the formation of embryonic zebrafish vasculature.

To process and analyze the large amount of data generated, we designed customized, automated and parallelized image processing tools in Fiji and FunImageJ. With a novel approach of vascular segmentation, a precise quantification of the vascular network's growth over the first days of development was obtained. Further analysis of the imagery data revealed that parts of the vasculature showed different degrees of symmetry and variation. Moreover, analysis of calcium signaling suggested that variation on a macroscopic level was already established on a signaling level.

Our multi-sample imaging pipeline further paves the way for many other quantitative long-term imaging studies such as xenotransplantation experiments or small-scale screens. It advocates a holistic approach based on multi-sample imaging using SPIM with integrated data processing and analysis to reveal and understand biological processes that occur over long time periods.

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Terms and Conditions

Yes

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