MOVIE IMAGING: HIGH-SPEED AND TERABYTE-SCALE IMAGING PIPELINE OF LIGHT-SHEET MICROSCOPY

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CUBIC tissue-clearing methods enable us to visualize individual organs and even to some entire mammals at sub-cellurar level[1]. Combined with light-sheet microscopy and image analysis, we can try to collect structural and molecular expression information on mammalian organs or bodies and large human specimens in a rapid manner. However, large specimens require terabyte-scale image data, and therefore the throughput of data generation remains a severe bottleneck for biological and medical applications handling numerous samples.

We developed a high-speed volumetric imaging system named as MOVIE imaging (MOVIng observation with Efficient real-time autofocus) for efficient volumetric imaging, which has integrated 1) continuous acquiring (MOVIE-scan), 2) real-time autofocusing (MOVIE-focus) and 3) skipping of blank images (MOVIE-skip) (Figure 1) [2] into a custom-built light-sheet fluorescence microscopy.

The image collection time was shortened to within a few hours per mouse whole organ. For example, using an adult mouse whole-brain sample treated by CUBIC-L/CUBIC-R+, the throughput of 50 ms of exposure time was measured as 0.56 TB/h and total data size was 2.5 TB using 10x objective lens with novel imaging system, comparing with 0.15 TB/h and 5 TB with previous imaging scheme. Compared with the previous report, acquisition time per brain also became 5-8.5 times shorter and total data size was reduced to half [3]. Also, the image quality improved because MOVIE-focus kept in focus throughout the sample.

Thus, the pipeline realizes a novel platform for the high-speed organ-scale imaging and will promote next-generation biomedical research targeting a large number of samples in a practical timescale.

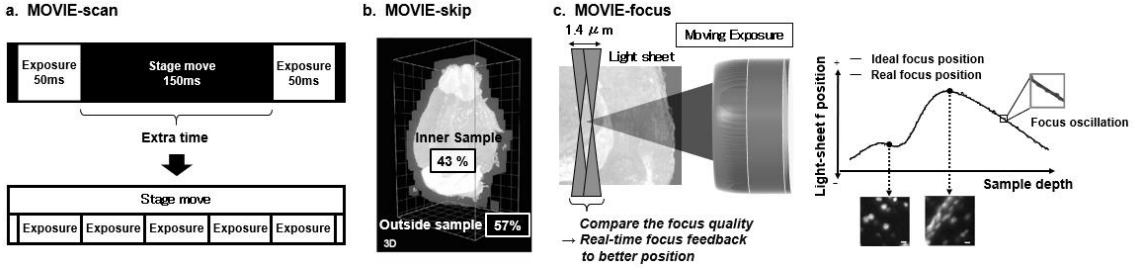

Figure 1: MOVIE imaging

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