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Theses of the Ph.D. Dissertation
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1 Introduction

2 DualMouse SPIM

3 B^{3}D image compression algorithm

other papers cited here huisken [1] muvi spim [2]

4 New scientific results

Thesis I. *I have designed and constructed a new light-sheet microscope suitable for high sensitivity imaging of delicate samples. This setup greatly improves existing solutions by employing two high NA objectives*

Corresponding publications: [J1],[J2], [J3]

More description coming.

Thesis II. *I have developed a GPU-based image procesing pipeline for multi-view light-sheet microscopy that enables real time fusion of opposing views.*

Corresponding publications: [C1], [C2], [C3]

Thesis Group II.

Thesis III. *I have developed a new image compression algorithm that enables noise dependent lossy compression of light microscopy images, and can reach a compression ratio of 100 fold while preserving the results of downstream data analysis steps.*

Corresponding publications: [J4], [C1], [C2], [C3]

All microscopy images contain inherent noise, that is

Trying some formulas inline $q = 1\sigma$. And more formuals in their own line:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1}$$

Thesis IV. *I have developed a new GPU-based image compression library, B^3D, that implements the algorithm described in Thesis III, and allows for real time compression of microscopy images with a throughput of up to 1 GB/s.*

Corresponding publications: [J4], [C1], [C2], [C3]

B^3D is an efficient, GPU-based image compression library allowing lossless and noise dependent lossy compression of microscopy images. Since many high-speed microscopy methods generate immense amounts of data, easily reaching terabytes per expriment, image compression is especially important to efficiently deal with such datasets.

5 Application of the results

The Author's Journal Publications

[J1] G. de Medeiros, B. Balázs, and L. Hufnagel. "Light-sheet imaging of mammalian development". *Seminars in Cell & Developmental Biology*. TelocytesTissue morphodynamics 55 (July 2016), pp. 148–155. DOI: 10.1016/j.semcdb.2015.11.001 (cit. on p. 1).

[J2] P. Strnad, S. Gunther, J. Reichmann, U. Krzic, B. Balazs, G. de Medeiros, N. Norlin, T. Hiiragi, L. Hufnagel, and J. Ellenberg. "Inverted light-sheet microscope for imaging mouse pre-implantation development". *Nature Methods* 13.2 (Feb. 2016), pp. 139–142. DOI: 10.1038/nmeth.3690 (cit. on p. 1).

[J3] P. Hoyer, G. d. Medeiros, B. Balázs, N. Norlin, C. Besir, J. Hanne, H.-G. Kräusslich, J. Engelhardt, S. J. Sahl, S. W. Hell, and L. Hufnagel. "Breaking the diffraction limit of light-sheet fluorescence microscopy by RESOLFT". *Proceedings of the National Academy of Sciences* 113.13 (Mar. 2016), pp. 3442–3446. DOI: 10.1073/pnas.1522292113 (cit. on p. 1).

[J4] B. Balazs, J. Deschamps, M. Albert, J. Ries, and L. Hufnagel. "A real-time compression library for microscopy images". *bioRxiv* (July 2017), p. 164624. DOI: 10.1101/164624 (cit. on p. 2).

The Author's Conference Presentations

[C1] B. Balázs, M. Albert, and L. Hufnagel. "GPU-based image processing for multiview microscopy data". *Light Sheet Fluorescence Microscopy International Conference*. Sept. 2016 (cit. on pp. 1, 2).

[C2] B. Balázs, M. Albert, and L. Hufnagel. "GPU-based image processing for multi-view microscopy data". *Focus on Microscopy*. Mar. 2016 (cit. on pp. 1, 2).

[C3] B. Balázs, M. Albert, and L. Hufnagel. “GPU-based image processing for multi-view microscopy data”. *Focus on Microscopy*. Bordeaux, France, Apr. 2017 (cit. on pp. 1, 2).

References

[1] J. Huisken, J. Swoger, F. Del Bene, J. Wittbrodt, and E. H. K. Stelzer. “Optical Sectioning Deep Inside Live Embryos by Selective Plane Illumination Microscopy”. *Science* 305.5686 (2004), pp. 1007–1009 (cit. on p. 1).

[2] U. Krzic, S. Gunther, T. E. Saunders, S. J. Streichan, and L. Hufnagel. “Multiview light-sheet microscope for rapid in toto imaging”. *Nature Methods* 9.7 (July 2012), pp. 730–733. DOI: 10.1038/nmeth.2064 (cit. on p. 1).