

TOWARDS FAST AND RELIABLE MULTIVIEW RECONSTRUCTION OF MICROSCOPICAL IMAGES

Maja Temerinac-Ott

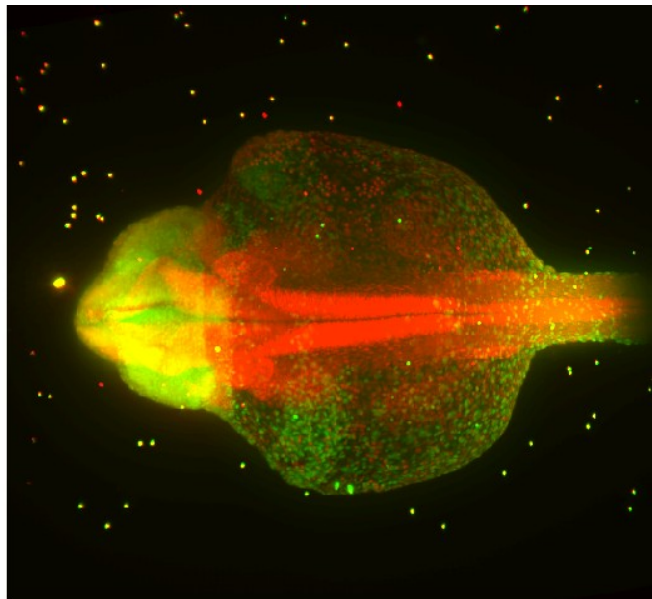
Multiview Reconstruction

- Registration
 - Bead-based
 - Image-based

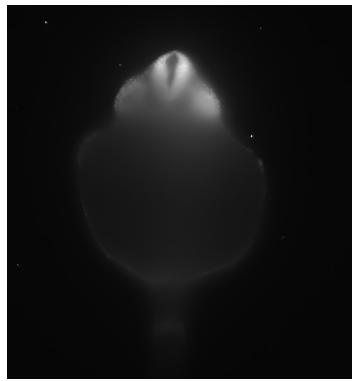
- Fusion
 - Blending (Signal-based)
 - Deconvolution (Model-based)

Bead-based Registration

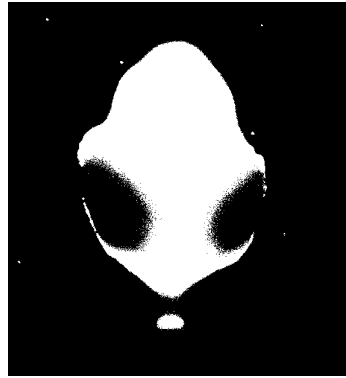
- Extraction of Bead positions
- Find identical points in different views using local descriptors
- Use point correspondences to register the views



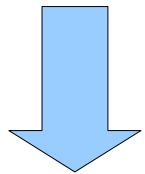
Extraction of the Bead positions



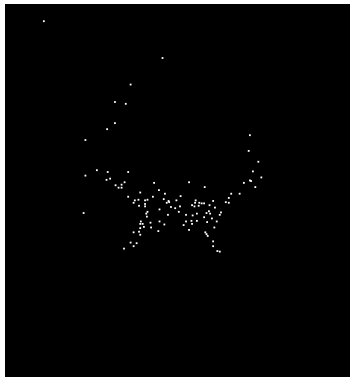
Threshold
image



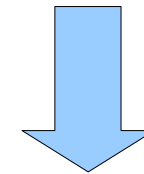
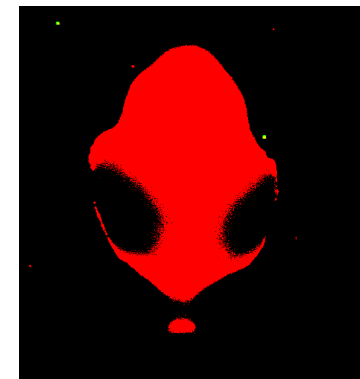
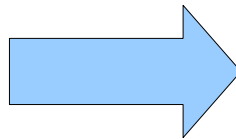
Detect
Big
Object



Extract
Local
maxima



Exclude all Local Maxima
on the Big Object



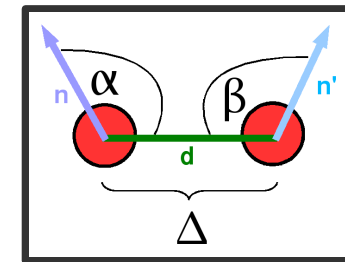
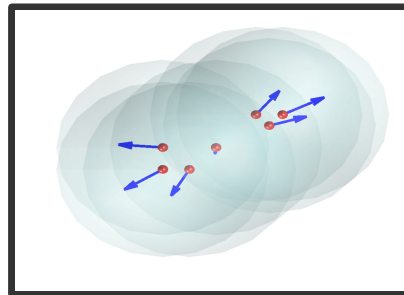
Use Big
Object
As a Mask

Group Averaging for Local Point Cloud Descriptors

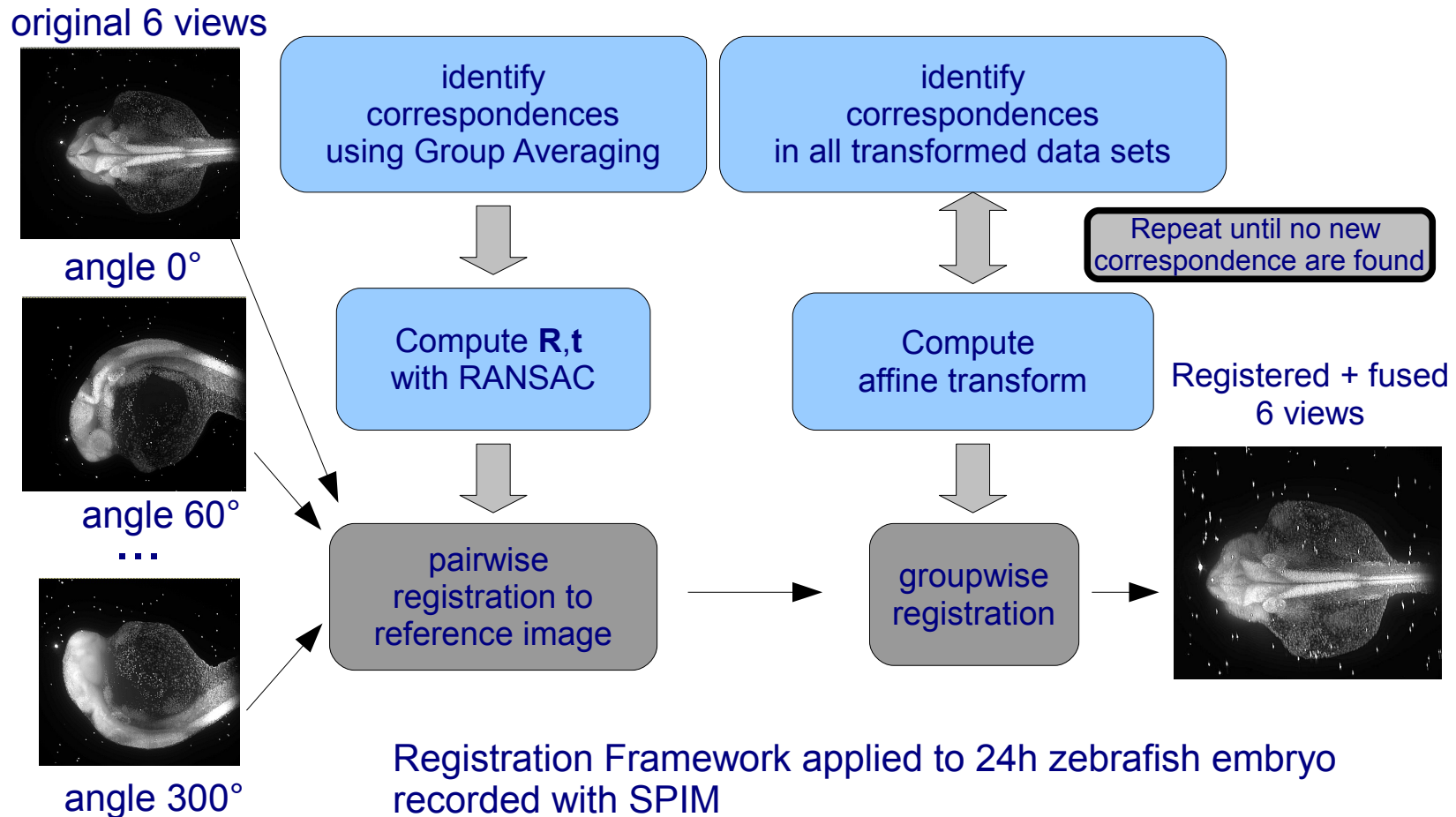
Publikation ICPR:

- M. Temerinac-Ott, M. Keuper and H. Burkhardt.,
„**Evaluation of a New Point Clouds Registration
Method based on Group Averaging**“, 20th
International Conference on Pattern Recognition, 23-26
August 2010, Istanbul

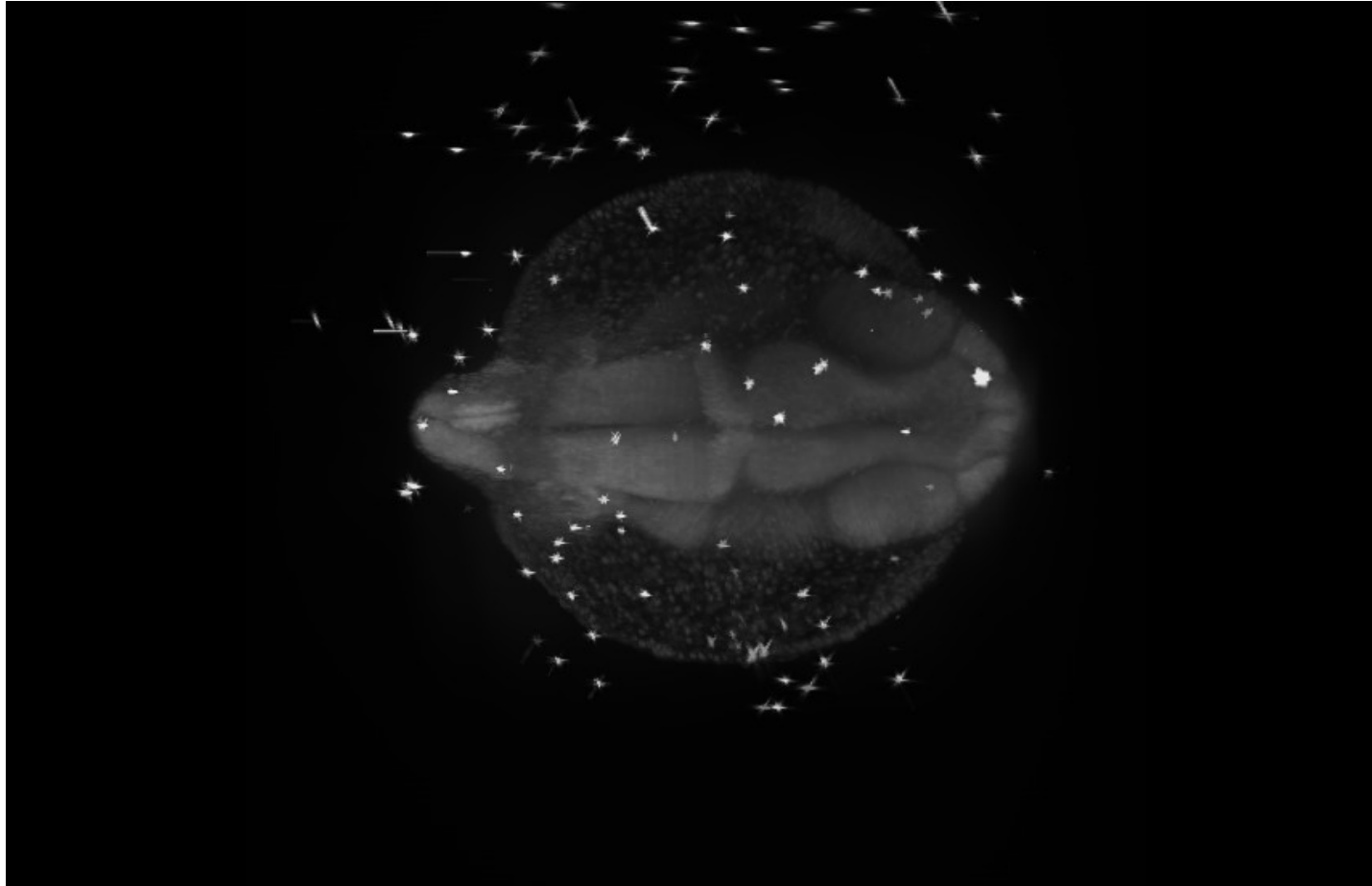
$$X(\mathbf{p}) = \sum_i \exp\left(-\frac{\|\mathbf{p}_i - \mathbf{p}\|^2}{\sigma}\right)$$



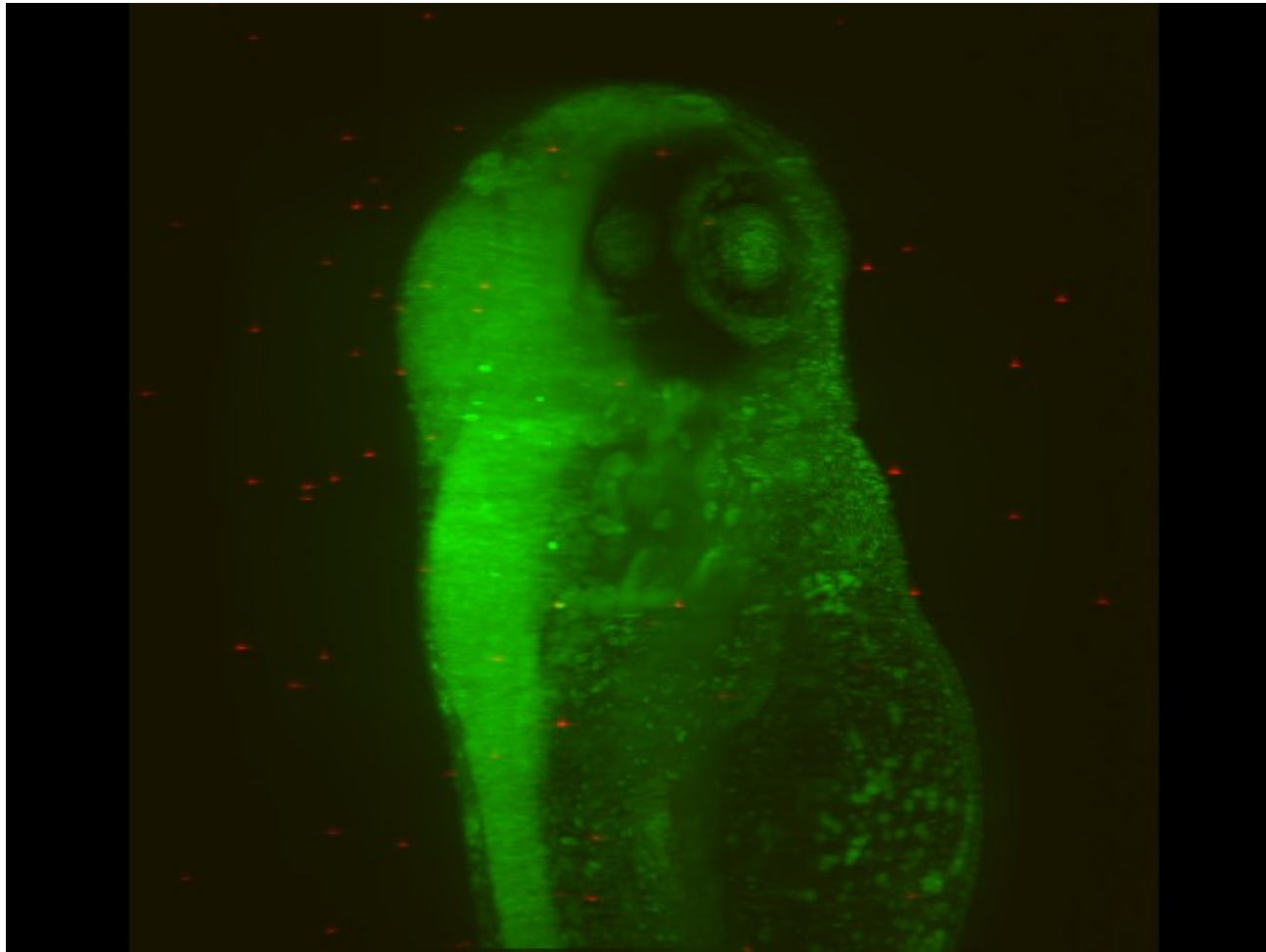
Workflow of the Registration Algorithm



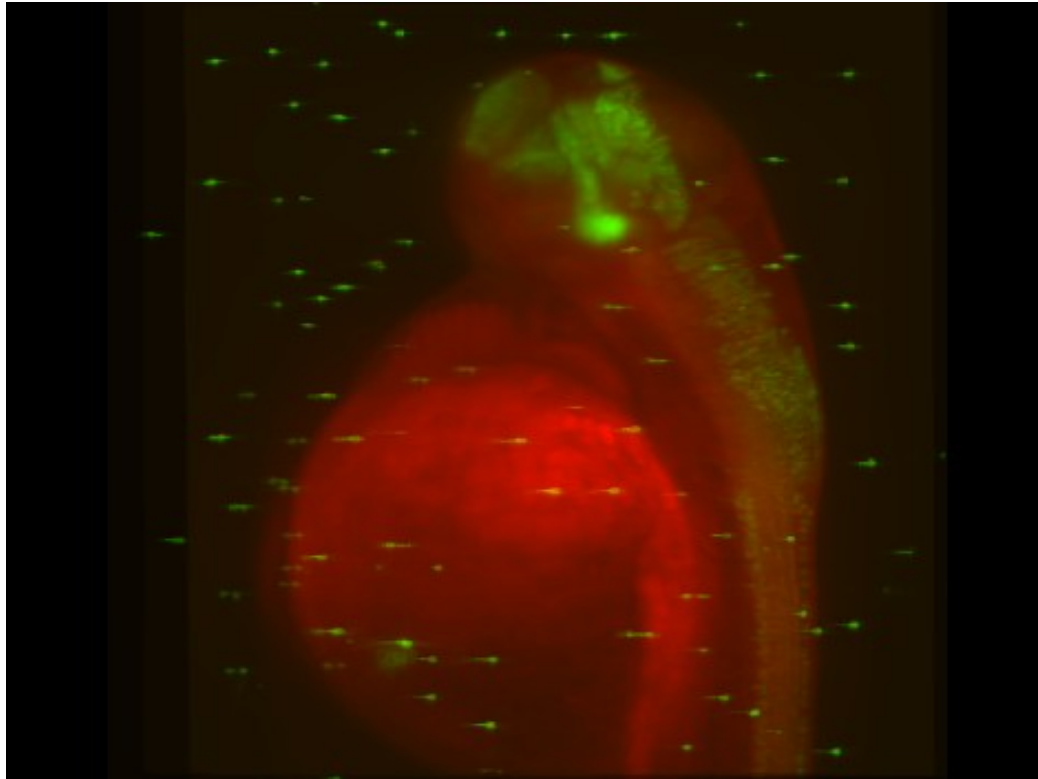
24h Zebrafish, SPIM Freiburg, Wolfgang Driever



Zebrafish 5days, SPIM San Francisco, Jan Huisken



Zebrafish 5days, SPIM San Francisco, Jan Huisken

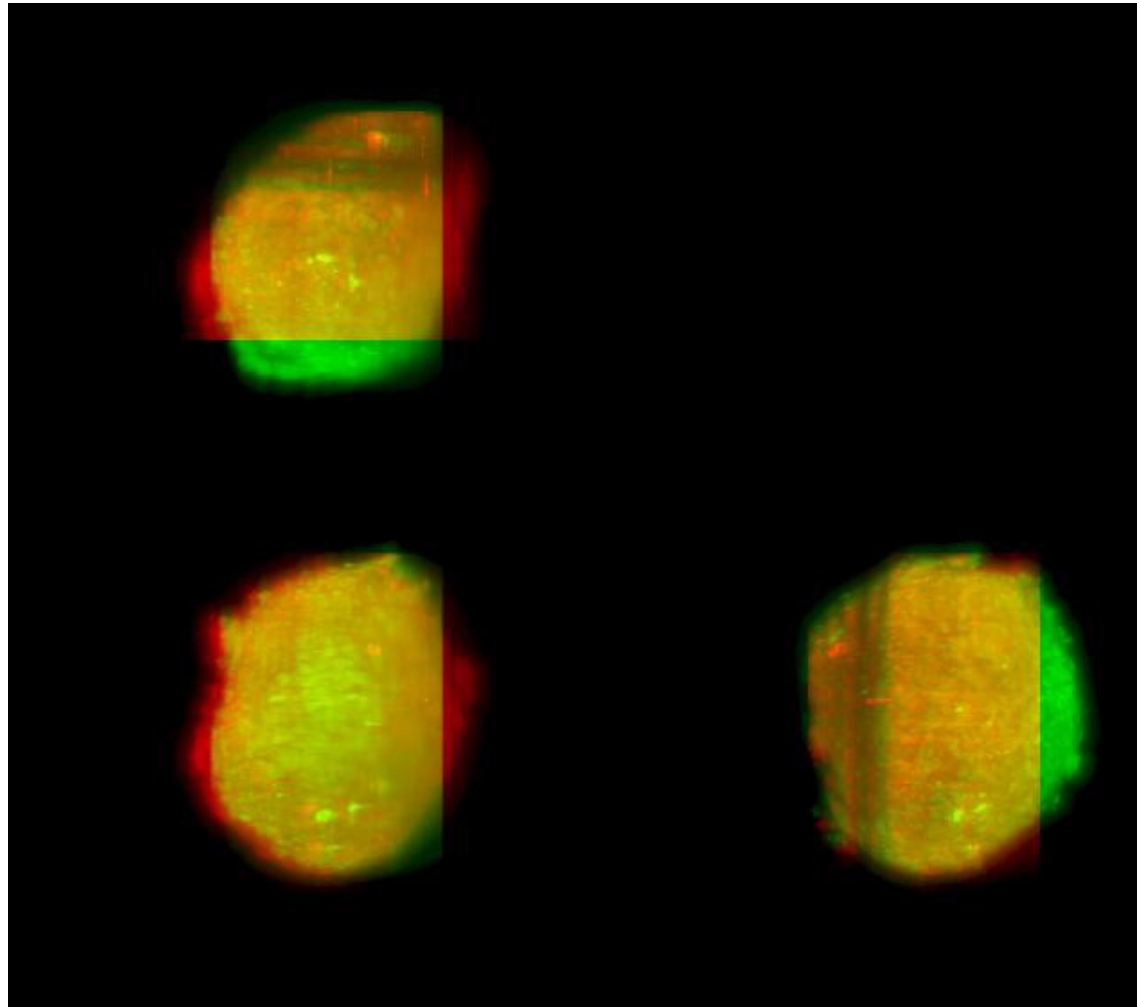


SSIM-based Registration

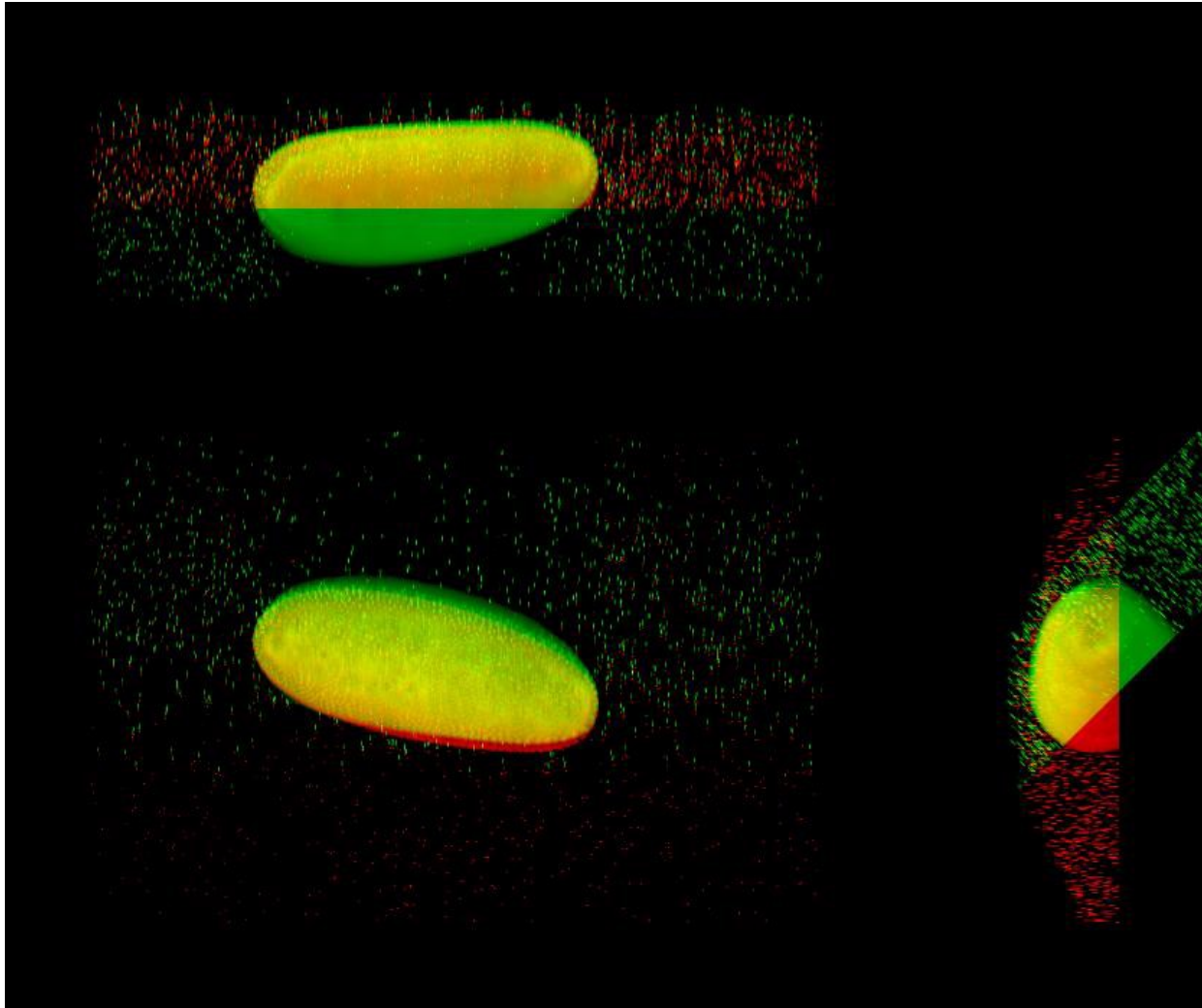
- Use only gray values from image
- Optimize SSIM between source and target image
- Use Best-Neighbor-Optimizer

$$SSIM(x, y) = \underbrace{\frac{2\mu_x\mu_y + C_1}{\mu_x^2 + \mu_y^2 + C_1}}_{\text{luminance}} \cdot \underbrace{\frac{2\sigma_x\sigma_y + C_2}{\sigma_x^2 + \sigma_y^2 + C_2}}_{\text{contrast}} \cdot \underbrace{\frac{\sigma_{xy} + C_3}{\sigma_x\sigma_y + C_3}}_{\text{structure}}$$

Cyst, SPIM Toulouse, Corinne De Lorenzo



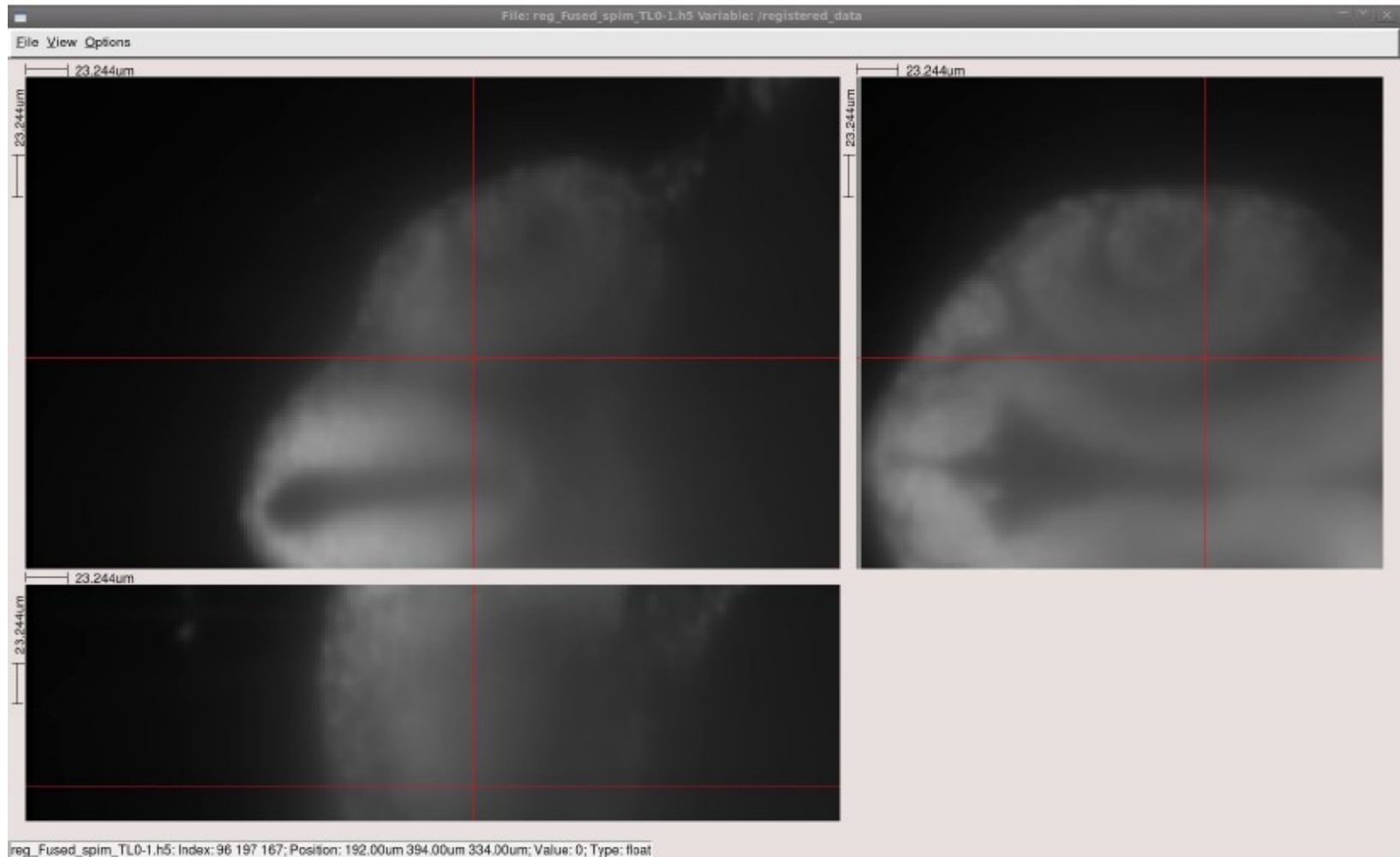
Drosophila egg, SPIM Dresden, Stephan Preibisch



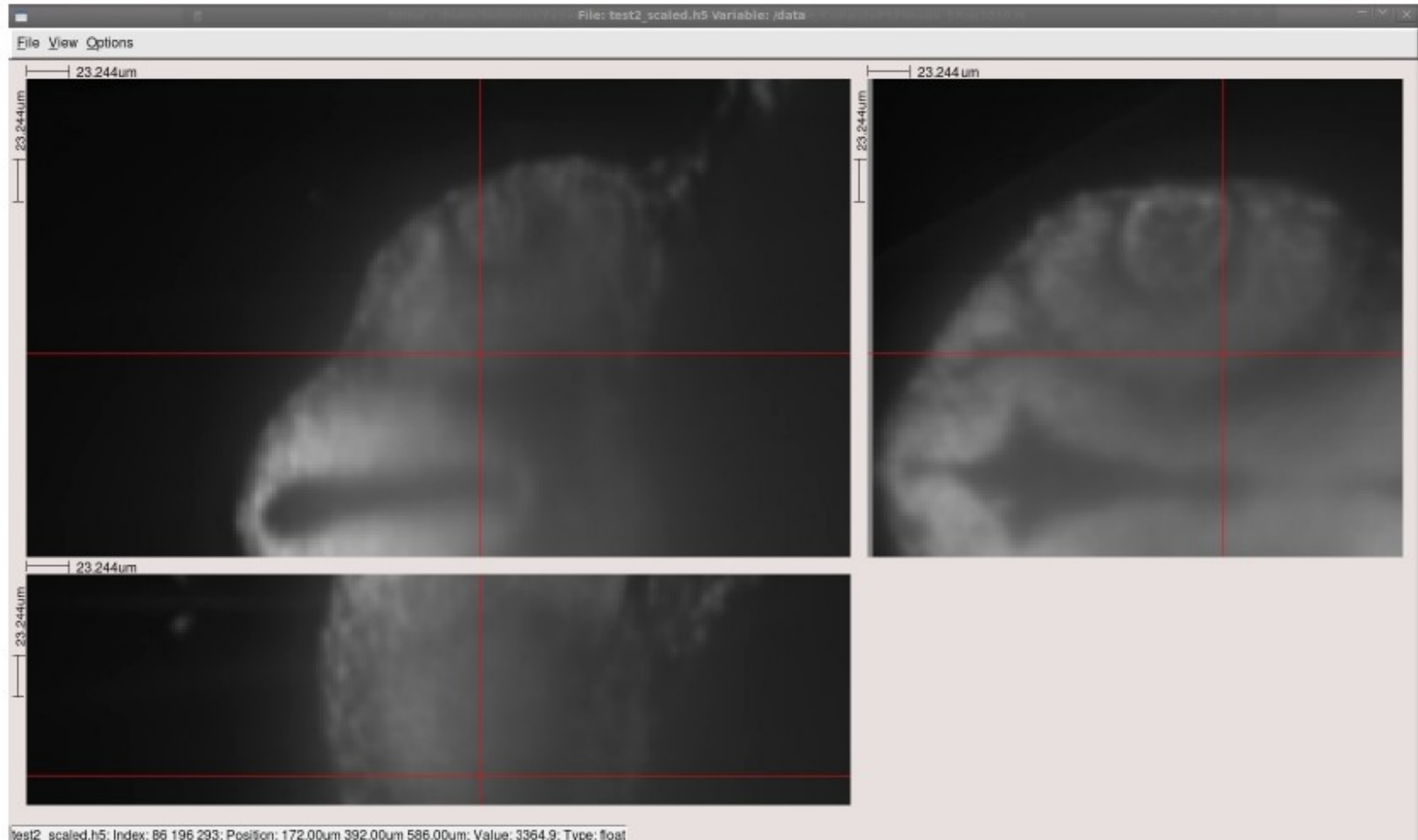
Deconvolution

- Modeling the spatially variant PSF
- Fast deconvolution by deviding the image in small blocks
- Lucy-Richardson deconvolution with TV regularization

Zebrafish 24h, SPIM Freiburg – Blending (Fiji-Plugin)



Zebrafish 24h, SPIM Freiburg - Deconvolution



Conclusions

- Beads are necessary in order to evaluate the quality of the registration
- Beads can be used to estimate the PSF locally
- For real life applications the multiview fusion algorithms must be fast
- The multiview fusion algorithms should be adapted to the biological questions which will be addressed during the image analysis