

A Semi-Automatic Image Morphing Technique for Biological Images

Marcel Spehr, André Viergutz, Stefan Gumhold

IMAGE MORPHING

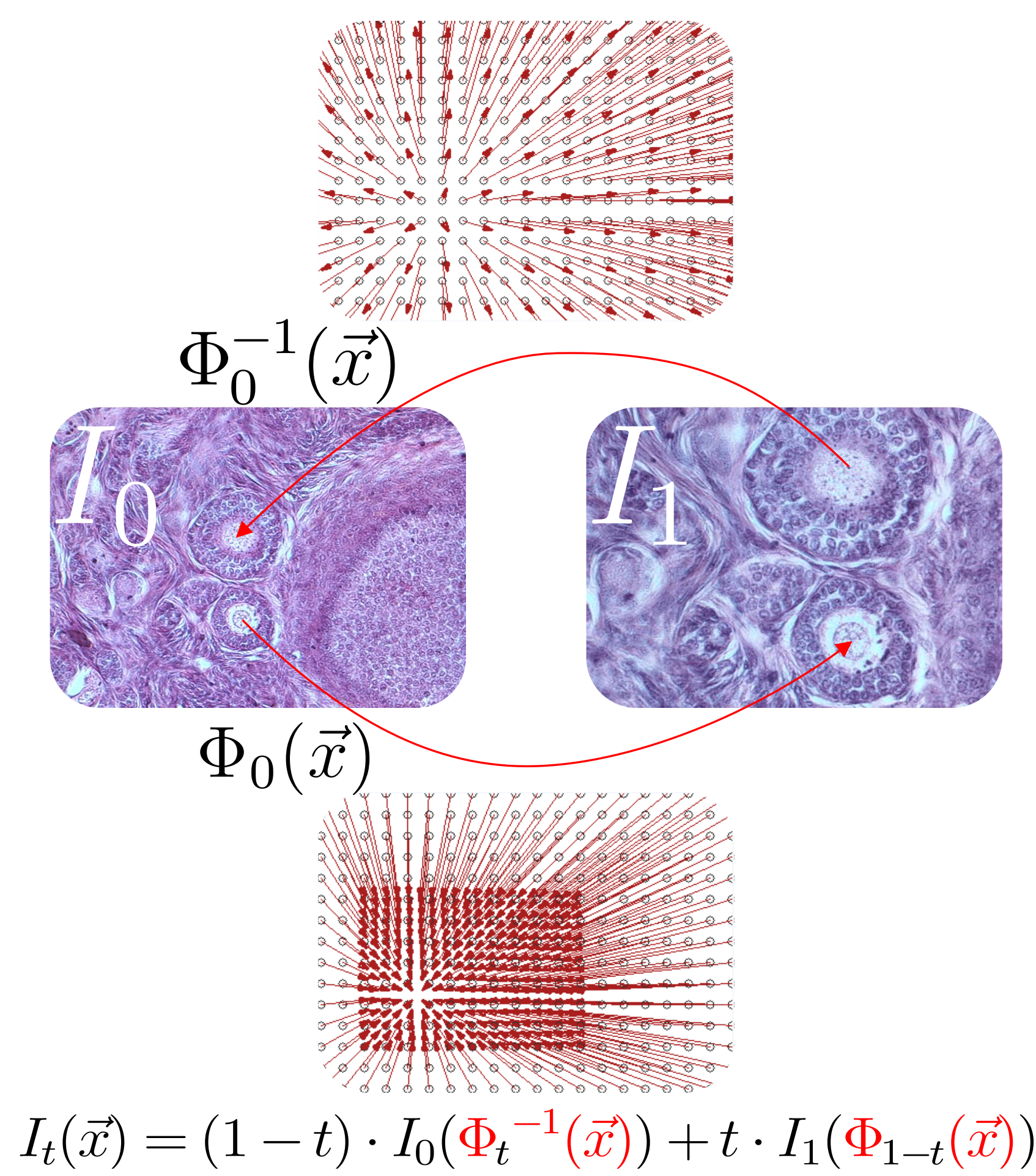
The process of transforming one image into another by generating a sequence of intermediate images to achieve a seamless transition.



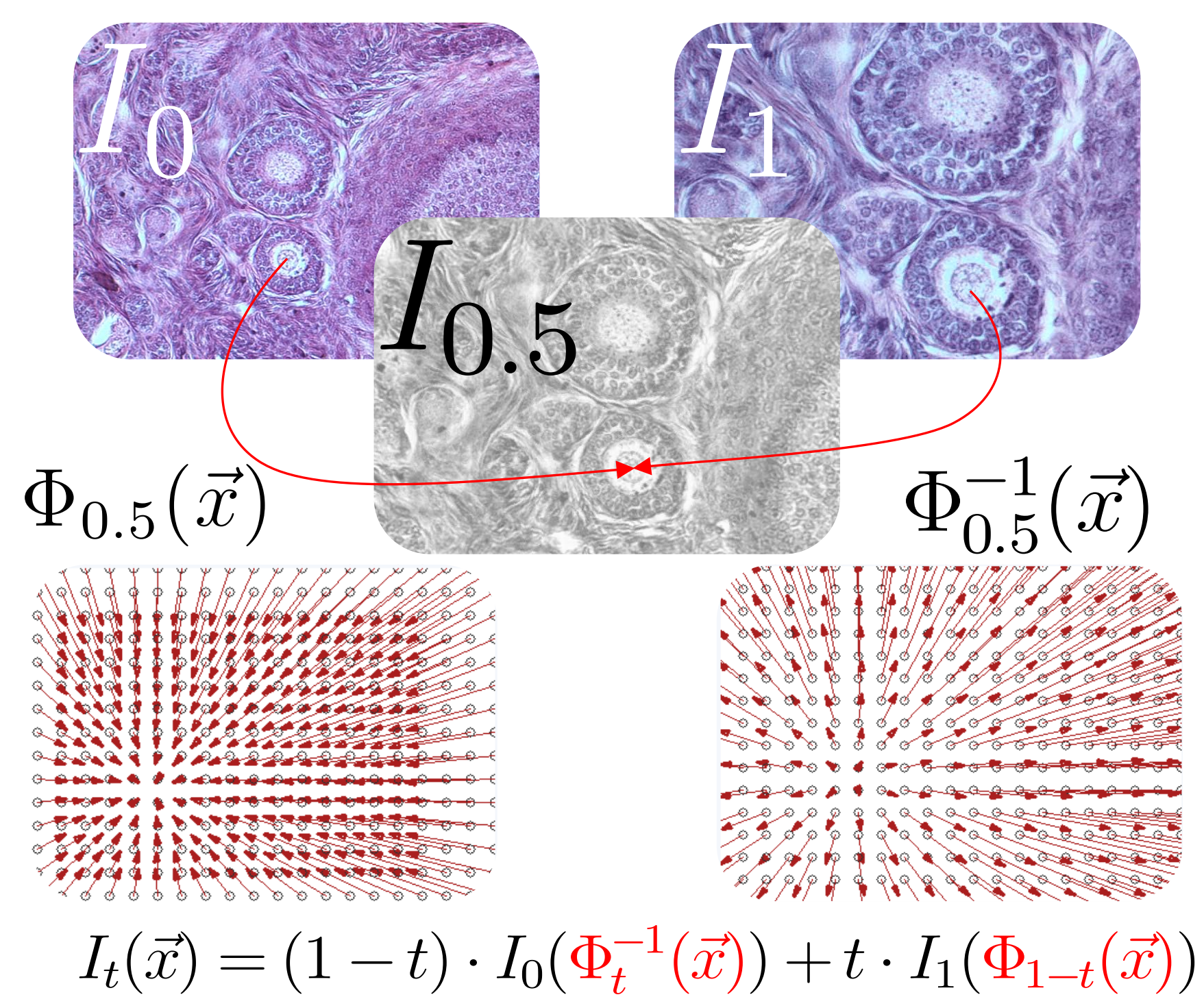
Video Reconstruction of Drosophila Embryo Morphogenesis using our method

Image Morphing Steps in Detail

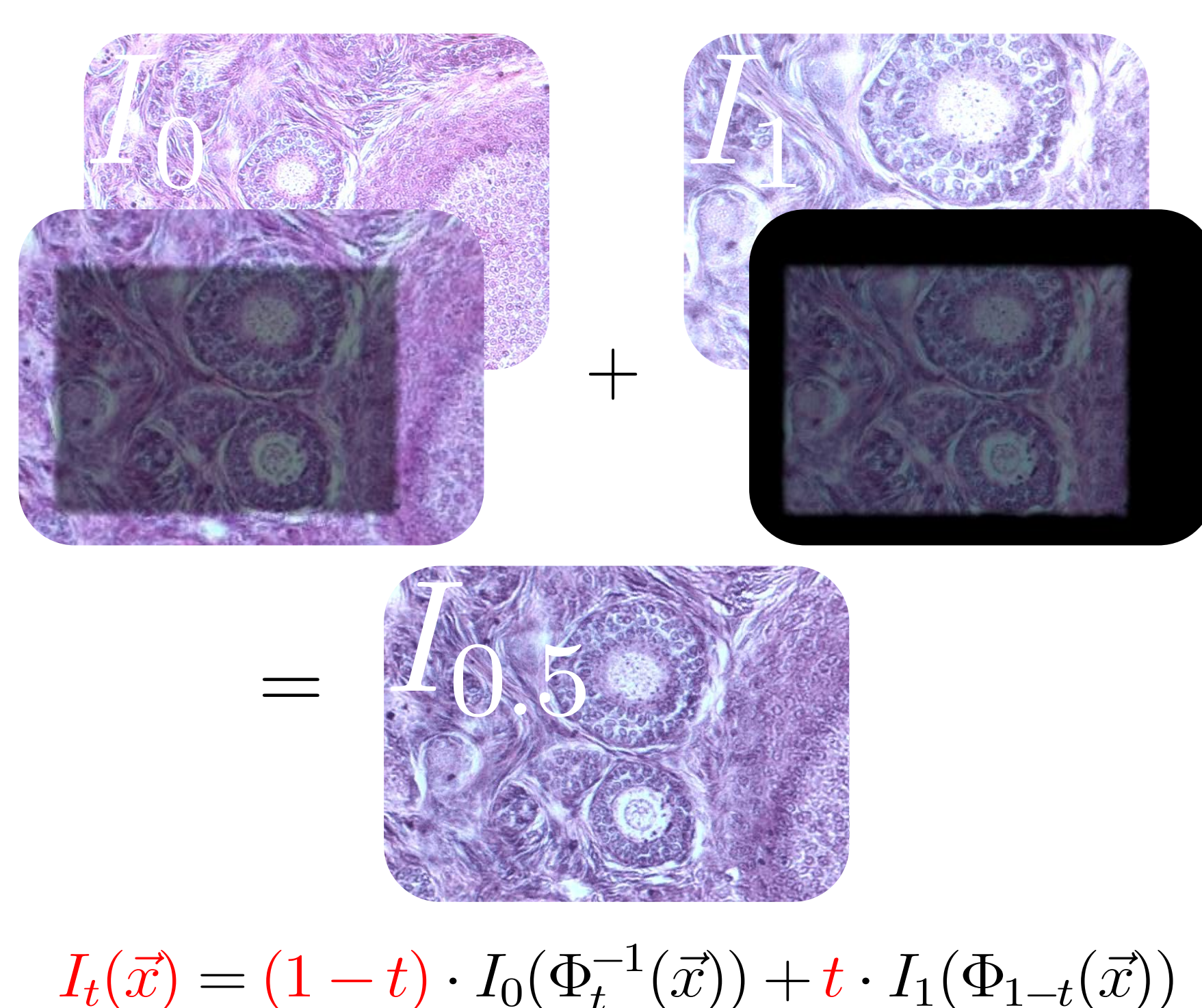
1. Correspondence Detection and Computation of Flow Fields $\Phi: \mathbb{R}^2 \rightarrow \mathbb{R}^2$



2. Interpolation of Flow Fields



3. Blending of Color Values



Non- Rigid Image Registration Methods Used to Define Flow Fields

Thin-Plate-Spline "User Driven"

- User supplied sparse correspondences
- Interpolation of dense flow field

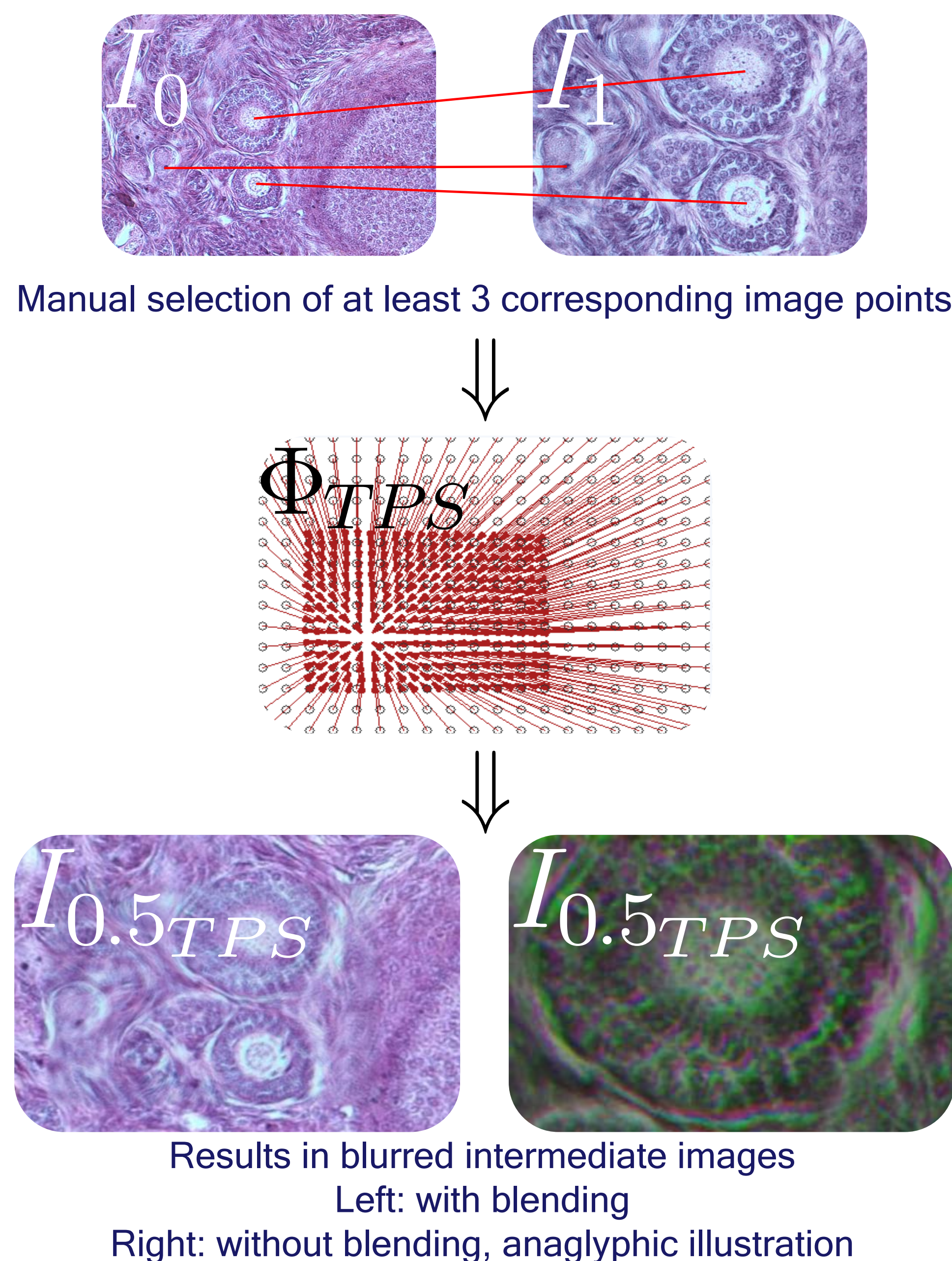
PRO:

- Very fast
- Can capture large scale differences, rotations, and translations

CONTRA:

- Exact mapping of points just for set correspondences, dense flow field is interpolated → only indirect control

Morphing results using TPS Flow Field alone



Application Areas

- Video reconstruction of
 - Continuous processes sampled at discrete time intervals
 - Zoom into cell tissue which was previously photographed at distinct, discrete scales
- Segmentation propagation through video footage

Optical Flow Estimation "Data Driven"

- Registration based on local image information and global flow field smoothness

PRO:

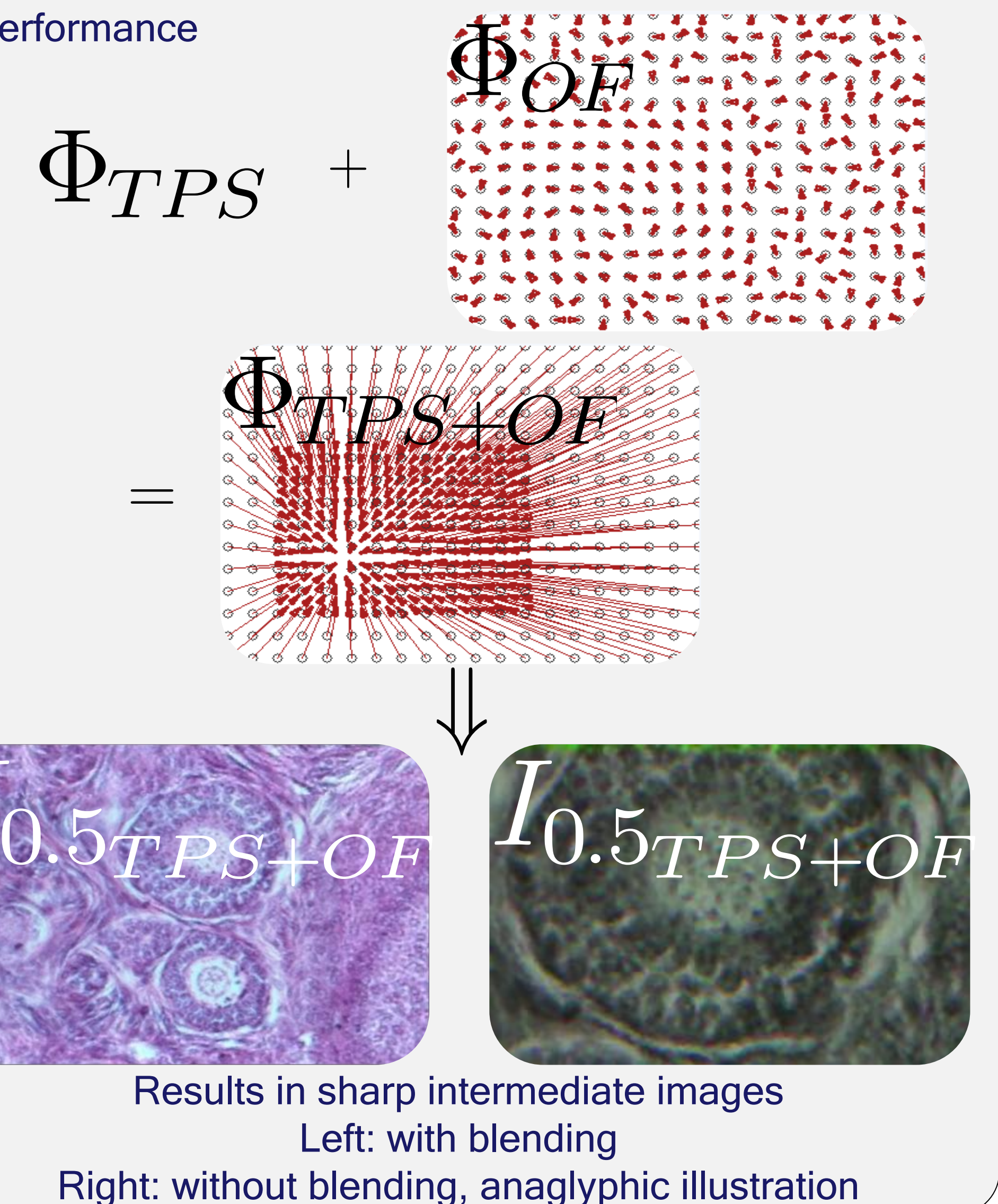
- Results in dense data-supported flow field

CONTRA:

- Unable to handle large image transformations in real time

Our Solution: A Combined Approach

- Thin-Plate-Spline used for pre-registration and pre-warping
- Optical Flow computation between pre-warped images takes care of field fine-tuning
- Utilized Optical Flow estimator employs graphics hardware acceleration → therefore close to real-time performance



Results

- An application that is very easy and intuitive to use
- Near real-time performance
- Produces visually pleasing results
- Robust to errors of manually set correspondences

References:

- Bookstein, F. (1989). Principal warps: Thin-plate splines and the decomposition of deformations. *IEEE Transactions on pattern analysis and machine intelligence*, 11 (6), 567-585.
- Werberger, M. a. (2009). Anisotropic Huber-L1 optical flow. *Proceedings of the British Machine Vision Conference*.
- Wolberg, G. (1998). Image morphing: a survey. *The Visual Computer*, 14 (8), 360-372.