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Status Masterarbeit

Themen

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- Registration Basics
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- Supervised Segmentation

Masterarbeit Overleaf

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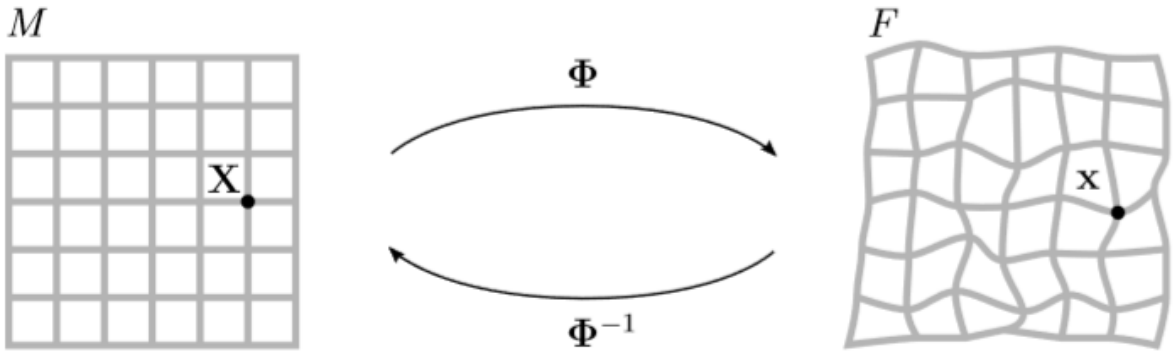
- Project

  https://de.overleaf.com/project/5e9f188573655800011ff5cd

- Synced with OLS

  https://pypi.org/project/overleaf-sync/

Registration Basics



deformation

displacement

$$\Phi^{-1}(\mathbf{x}) = \mathbf{x} + \mathbf{u}^{-1}(\mathbf{x})$$

warped

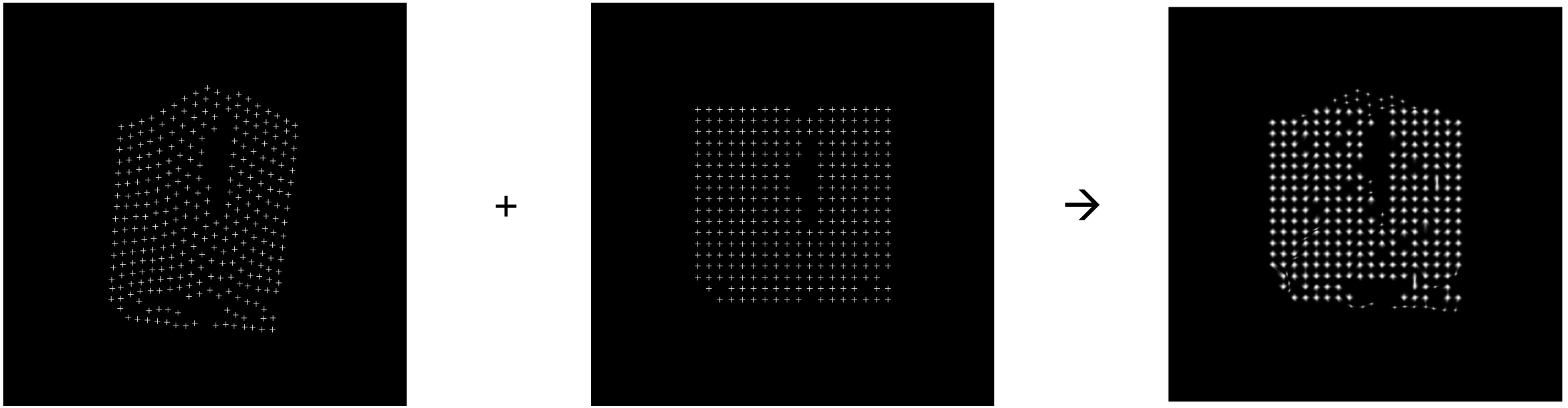
moving

fixed

$$w(\mathbf{x}) = (m \circ \Phi^{-1})(\mathbf{x}) \approx f(\mathbf{x})$$

Registration Basics

- The SyN algorithm from ANTs was tested on our data set.
- A purely intensity-based metric did not show sufficient results.
  - Image could be enhanced (background information) for better results.
  - An additional label-based metric should be tested.

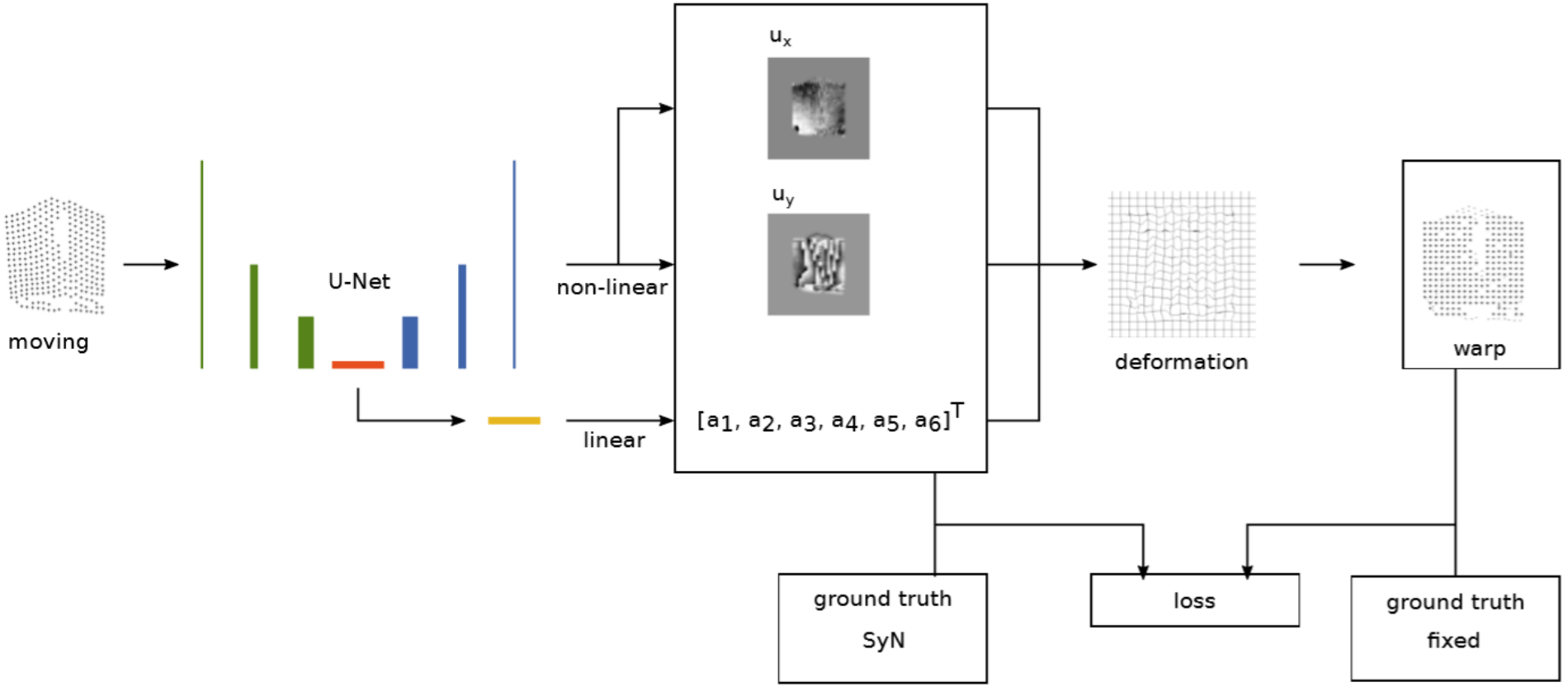


Registration Literature

- Deep learning approaches for registration were made in several publications.

Property	de Vos et al.	Fan et al.	Krebs et al.	Yang et al.
Registration Model	affine + B-spline	SyN	SVF	LDDMM
Framework	none	ANTs [?]	Log-Euclidean [?]	PyCA [?]
Parametric	true	false	false	false
Diffeomorphic	false	true	true	true
Metric variables	warp	warp + displacement	warp	warp
Metric type	intensity	intensity	intensity	intensity
Metric	MSD, CC, MI	MSD + MSD	CC	SSD
Transformation	linear + non-linear	linear + non-linear	linear + non-linear	linear + non-linear
Network Name	DLIR	BIRNet	-	Quicksilver
Network Model	deterministic	deterministic	probabilistic	probabilistic
Network Architecture	custom AE	filled U-Net	CVAE	BNN
Supervision	unsupervised	supervised	unsupervised	supervised
Modalities	inter, intra	intra	intra	inter, intra
Image space	3D	3D	3D	3D

Supervised Registration



Supervised Registration

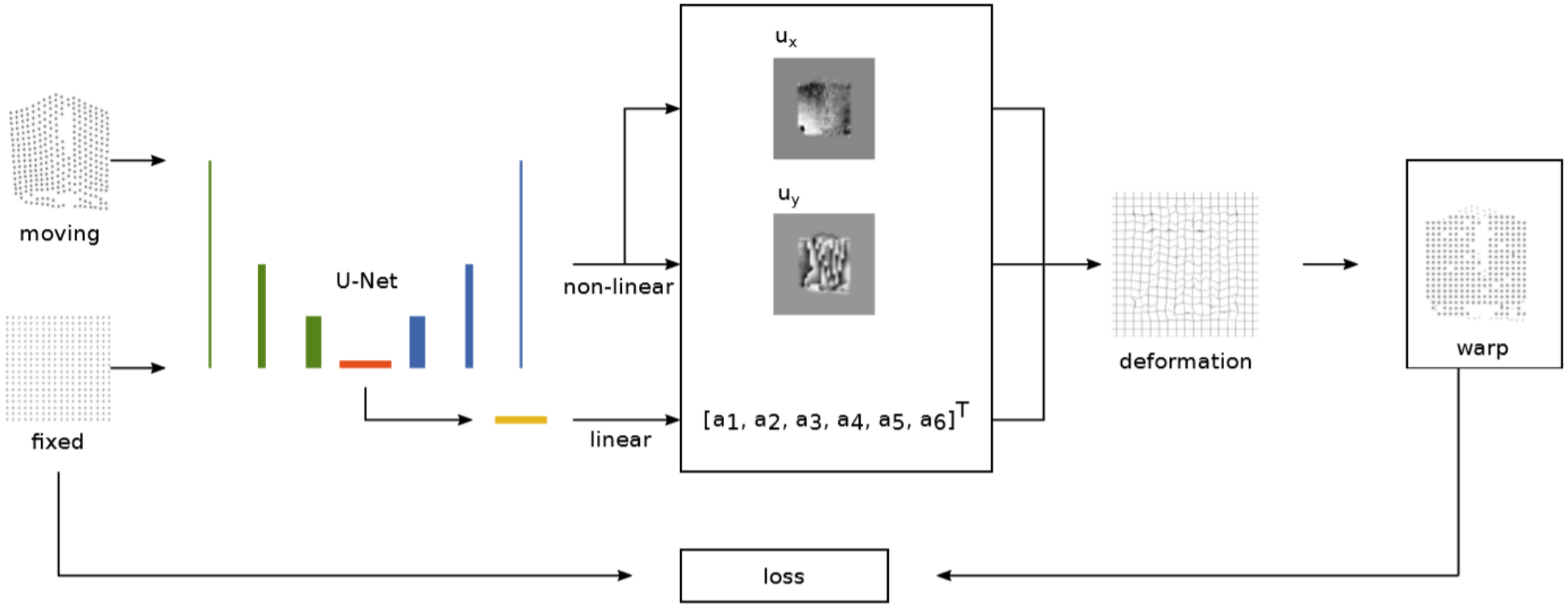
- Ground truth displacements and affine transformations can be generated with for example SyN. First trials have shown that a pure intensity-based metric is not sufficient.

- If intensity-based approach can not be improved, a label-based metric should be incorporated.

- A composed loss is proposed here similar to the one from Fan et al.

- The loss component coming from the warped and fixed image should take care of an intensity-based (optional label-based) metric.

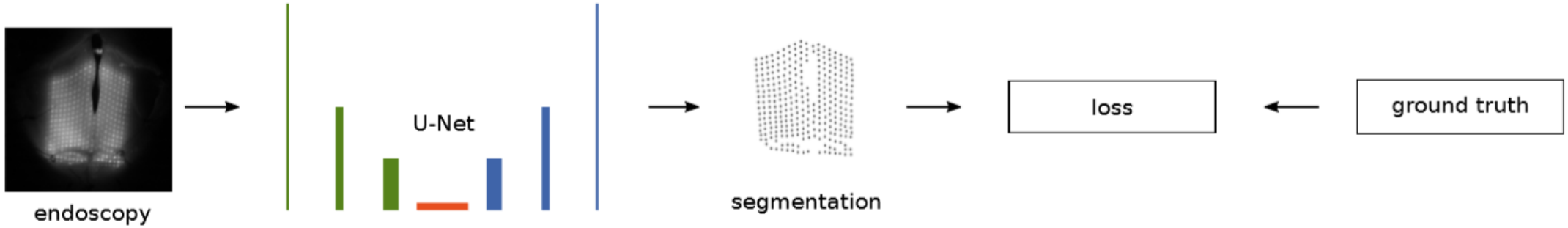
Unsupervised Registration



Unsupervised Registration

- The unsupervised approach will only work if we can find a proper way to work with intensity-based metrics.
- A label-based metric can not be applied here. This would lead again to a supervised task.
- If the unsupervised registration is feasible, the training can be improved with data synthetization through a probabilistic model. What would be the difference to simple data augmentation?

Supervised Segmentation



Supervised Segmentation

- Can we start with a hot-pixel segmentation?

- If we exclude hot-pixel segmentation right away, we need to first generate segmentation masks from the labeled data.

- Auxiliary training input like image gradients might be beneficial.