Comparing the performance of image registration frameworks (Voxelmorph, SPAM, Airlab) on video of retinal

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Agenda

- Introduction: Voxelmorph, SPAM, Airlab
  - Problem: does not work when directly apply on retina video
- Experiment 1: MNIST data
  - A. Moving images are affine transformations of fixed image (rigid)
  - B. Moving images are non-rigid transformation of fixed image
- Experiment 2: simpler image of retina vessel (Airlab only)
  - A. Moving images are affine transformations of fixed image
  - B. Add additional specific patterns to fixed image

Evaluation

Evaluation by mean squared error over all pixels intensity between the fixed image (F) and the transformed of moving image (G')

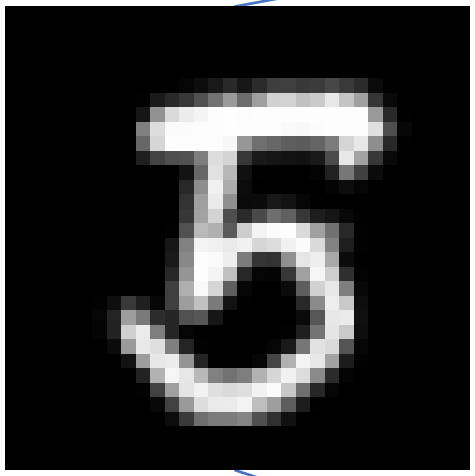
$$MSE = \frac{1}{XY} \sum_{x=1}^{X} \sum_{y=1}^{Y} (F(x,y) - G'(x,y))^2$$

Experiment 1: MNIST data

a. Moving images are affine transformations of fixed image (rigid)

Airlab

Translation x = -2
Translation y = -2



Fixed image

Rotation angle =
-20 degree

Moving image

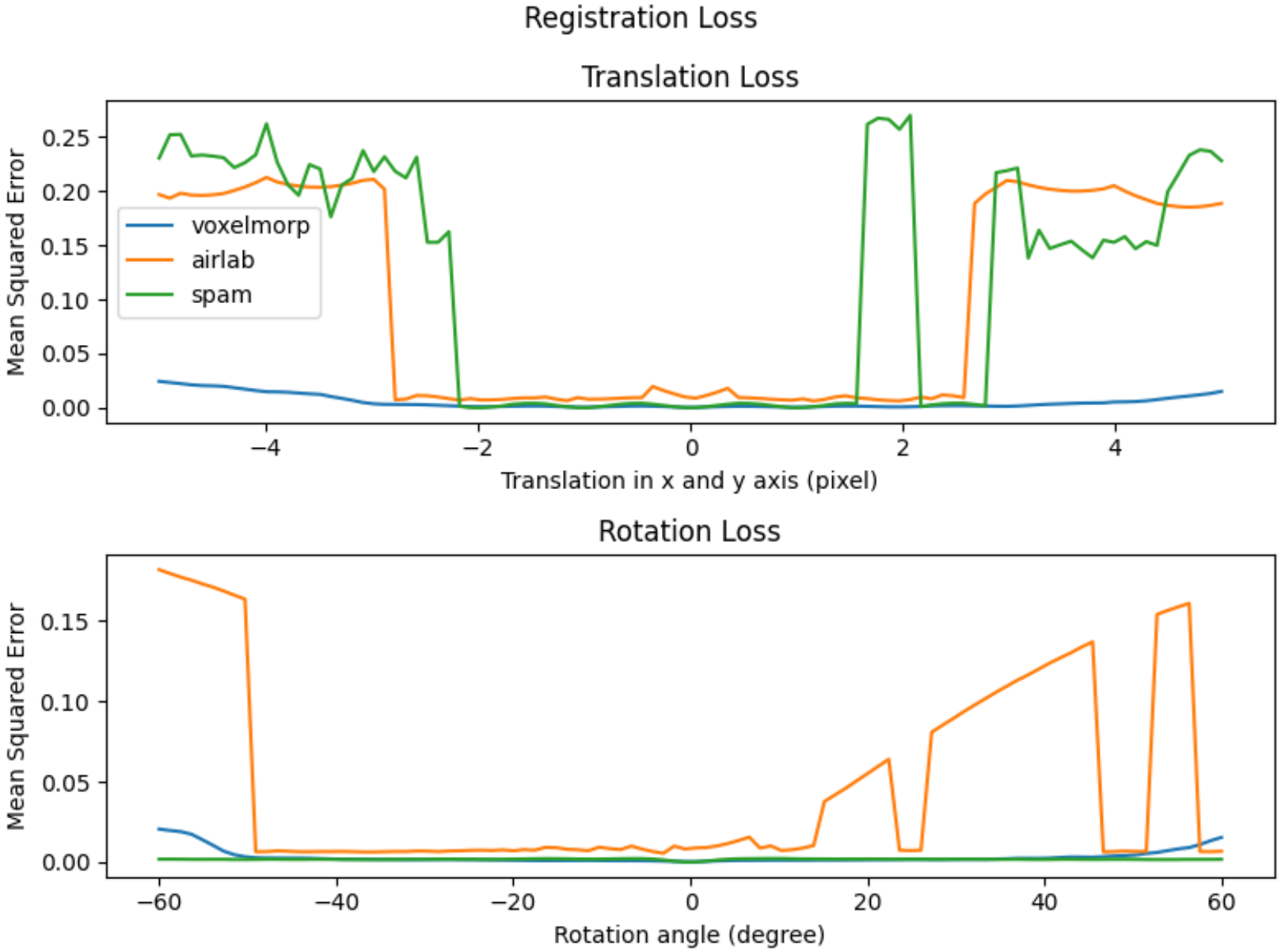
Overlay fixed and moving image

Transformed image

Overlay fixed and transformed image

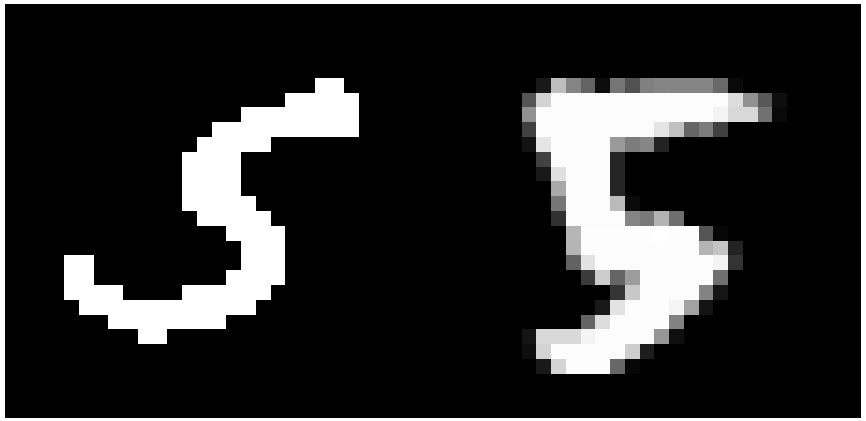
Comparison

$$t_x \in [-5, 5]$$
$$t_y \in [-5, 5]$$
$$\phi \in [-60, 60]$$



b. Moving images are non-rigid transformation of fixed image

Original MNIST data set number 5



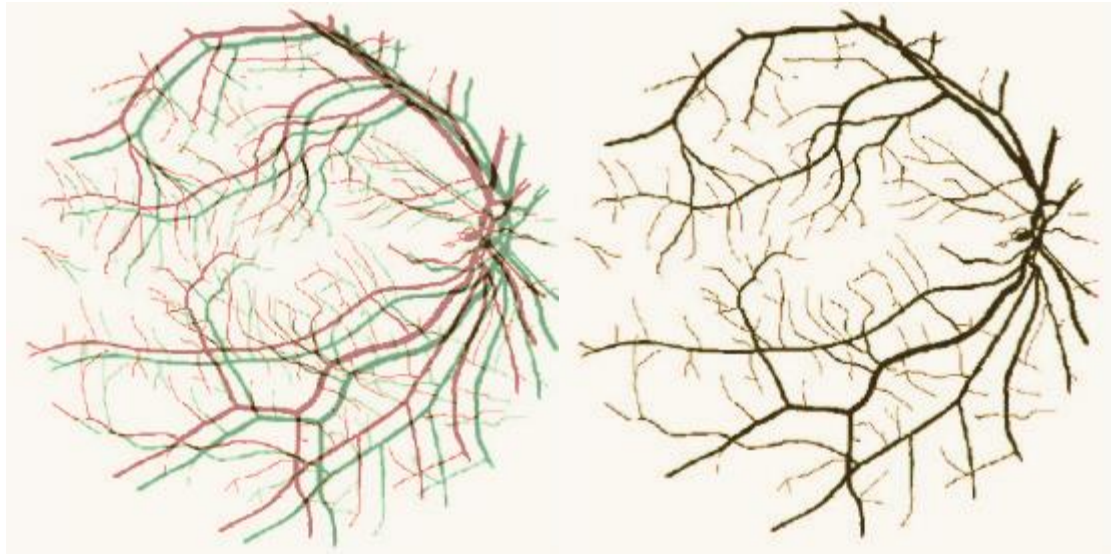
	Airlab	SPAM	Voxelmorph
Loss (mean for 1000 pairs)	0.09	4909 (diverge)	0.002
Speed(frame/second)	0.128	37.43	14.83

Experiment 2: simpler image of retina (Airlab only)

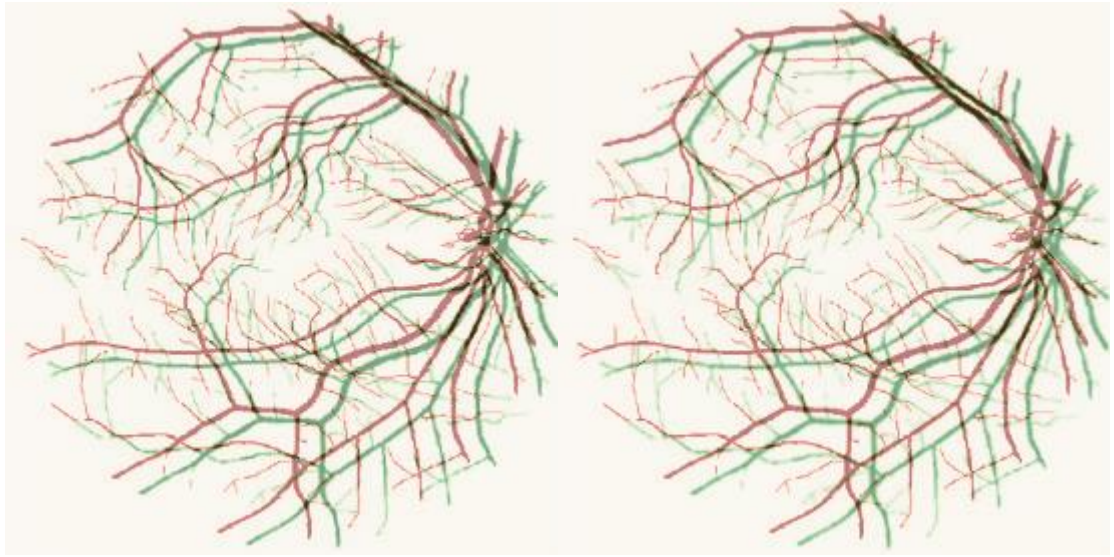
- Input: original fixed image

- X_trans = 10
- Y_trans = 5
- Rotation = 1 deg
- → well registered

- X_trans = 10
- Y_trans = 5
- Rotation = 2
- → does not work



- Overlay of fixed and moving image

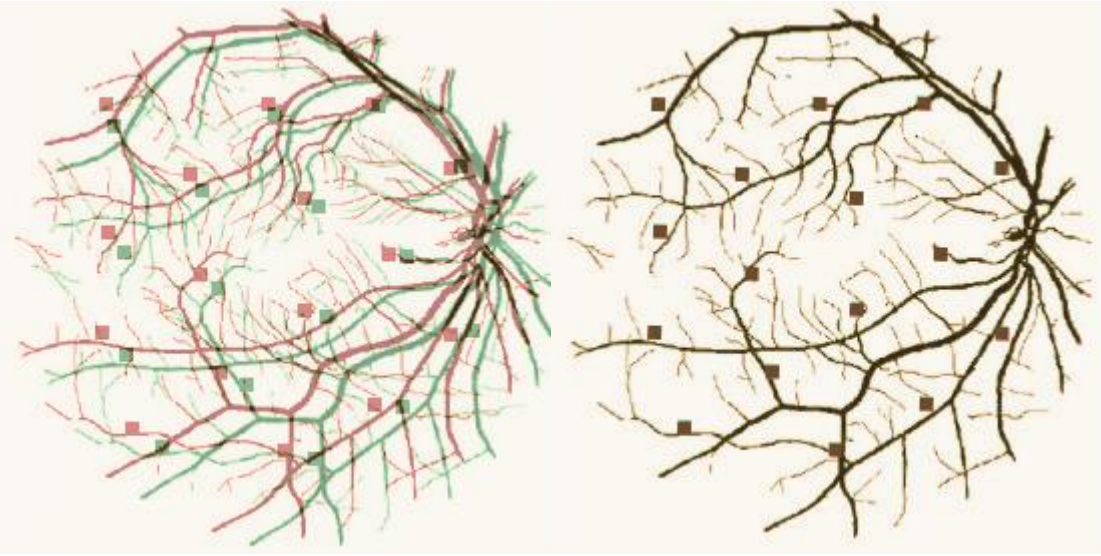


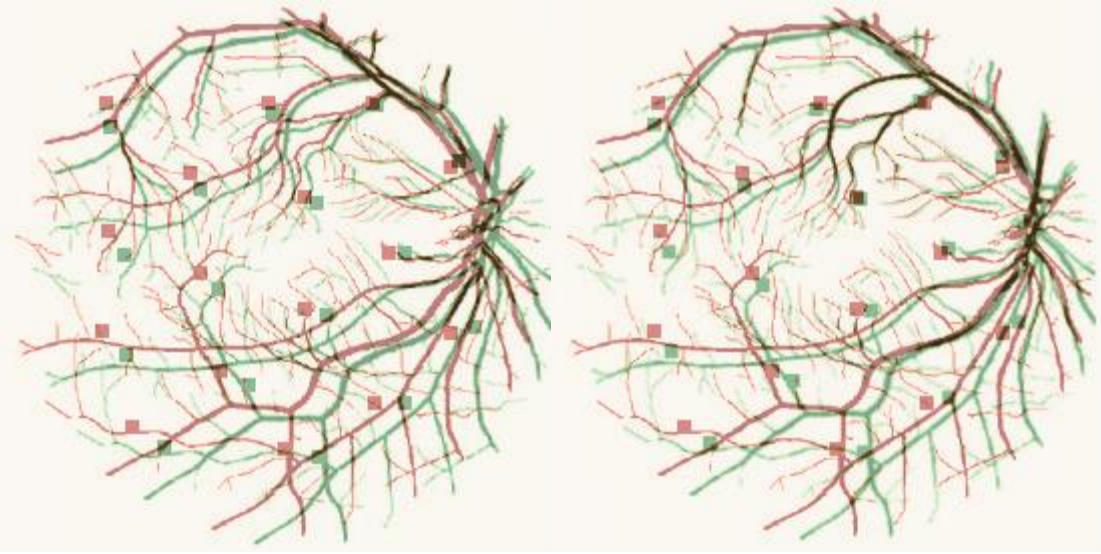
- Overlay of fixed and transformed image

- Input: fixed image with rectangles

- X_trans = 10
- Y_trans = 5
- Rotation = 4 deg
- → well registered up to 4 deg rotation

- X_trans = 10
- Y_trans = 5
- Rotation = 5 deg
- → does not work





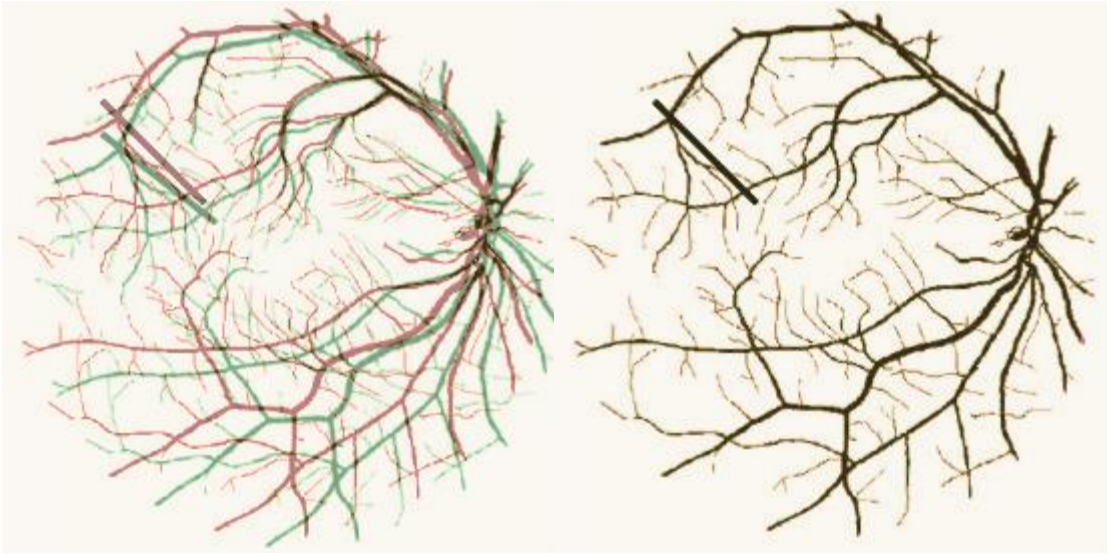
- Overlay of original images
- Overlay of fixed and transformed image

- Inputs are images with random lines

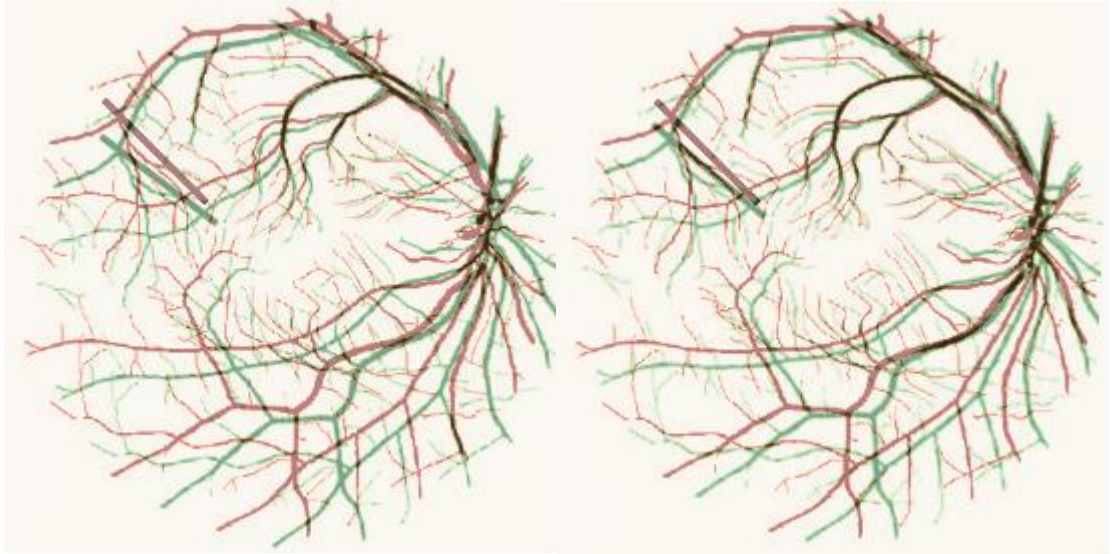
- X_trans = 10
- Y_trans = 5
- Rotation = 7 deg
- → well registered up to 4 deg rotation

- X_trans = 10
- Y_trans = 5
- Rotation = 8
- → does not work from 8 deg rotation

- Airlab applied on retinal images works even worst, increase the number of iteration does not help



- Overlay of original images



- Overlay of fixed and transformed image