ETH-ScopeM_Gkountidi

Contact

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Overview

Measure lymphatic vessel contractions before and after control or inhibitor injection.

Procedure

We first segment the lymphatic vessels using a custom-trained U-Net network and then monitor vessel contractions by measuring their radius variation over time.

1. **Lymphatic vessel segmentation**

1.1 Format training data

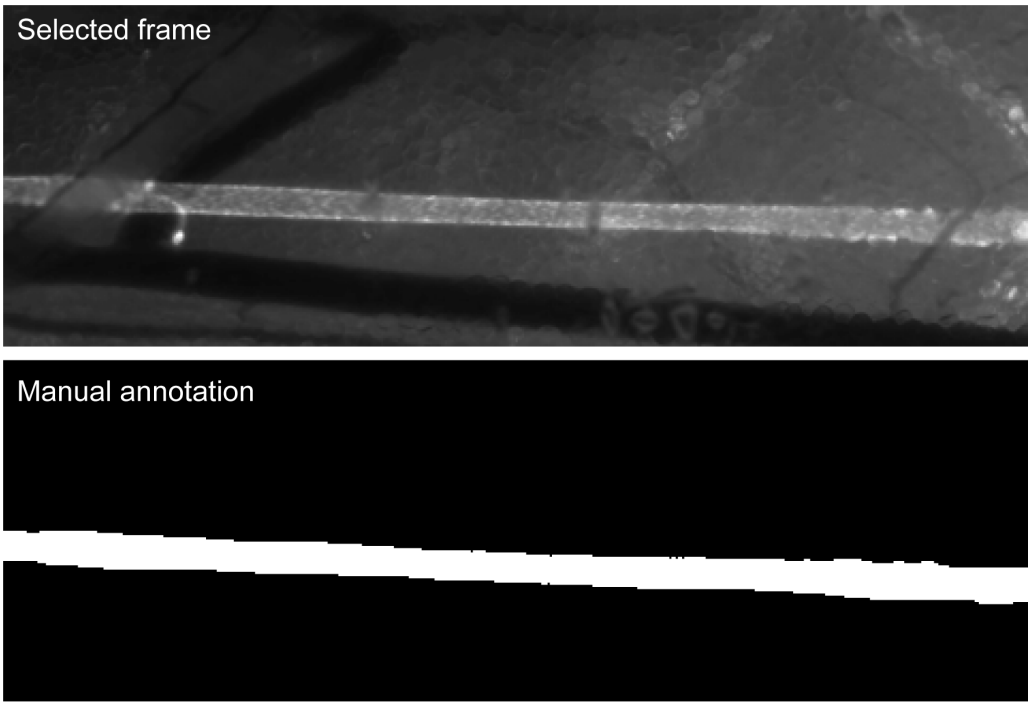
`extract.py`

- Open and convert `.avi` movies to `ndarray`
- Ramdomly select n frames in each movies
- Save selected frames as `.tif` files in the `data/train` folder as `[movie_name]_[frame_number].tif`

1.2 Annotate training data

`annotate.py`

- Sequentially open saved frames in `Napari` viewer
- Annotate vessels using the label brush tool
- Save annotated masks as `.tif` files in the `data/train` folder as `[movie_name]_[frame_number]_mask.tif`



1.3 Prepare data and train U-Net model

`train.py`

- Open selected frames and associated masks
- Reduce image resolution
- Normalize images (0 to 1)
- Data augmentation (flip, rotate, distord...)
- Setup U-Net architecture and parameters (epoch, batch size, loss...)
- Train the network and save weights as `model_weights.h5`

2. **Measure local vessel contraction**

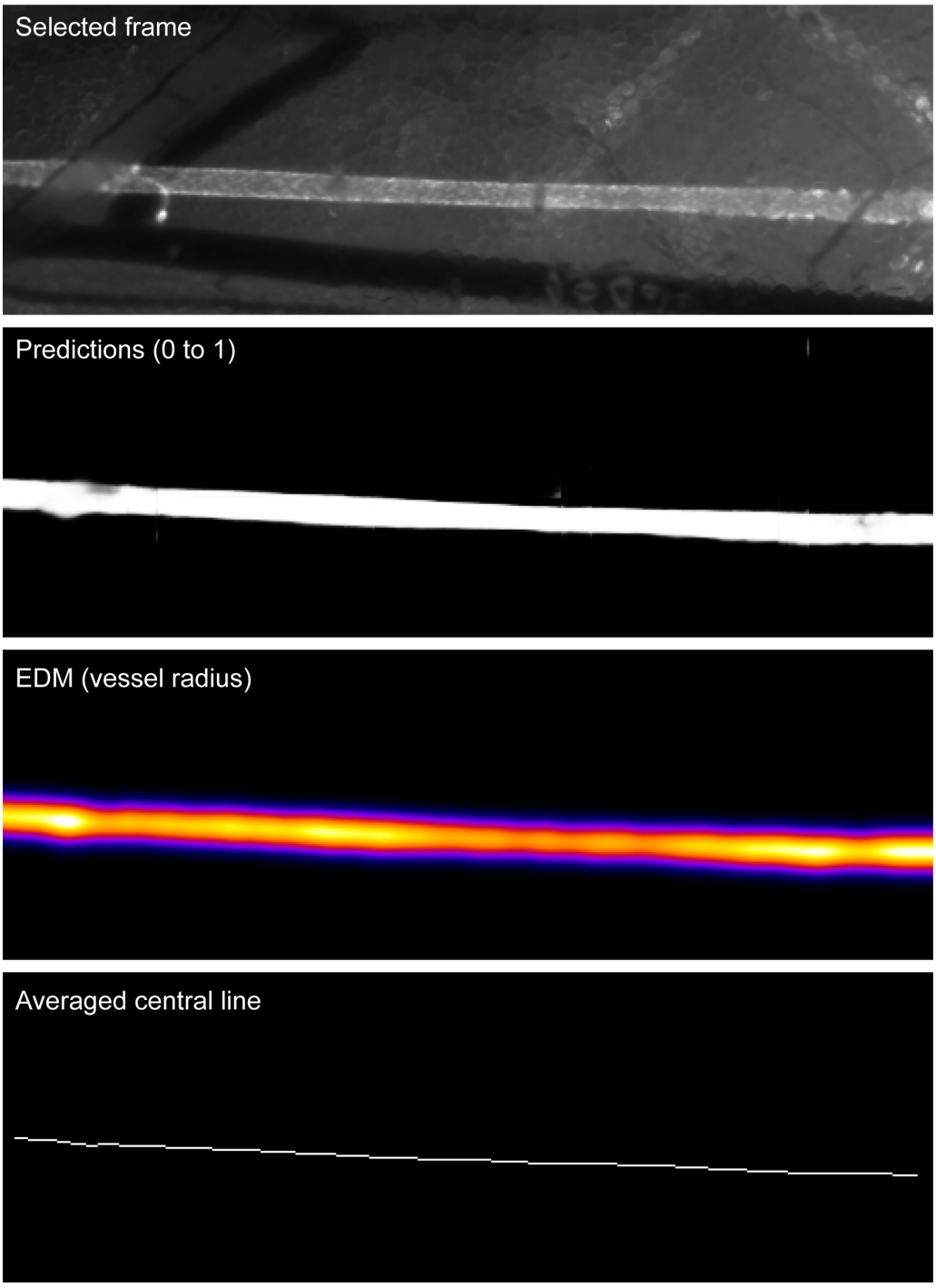
`analyse.py`

2.1 Prepare data and predict

- Open and convert `.avi` movies to `ndarray`
- Reduce image resolution
- Normalize images (0 to 1)
- Get predictions for all frames

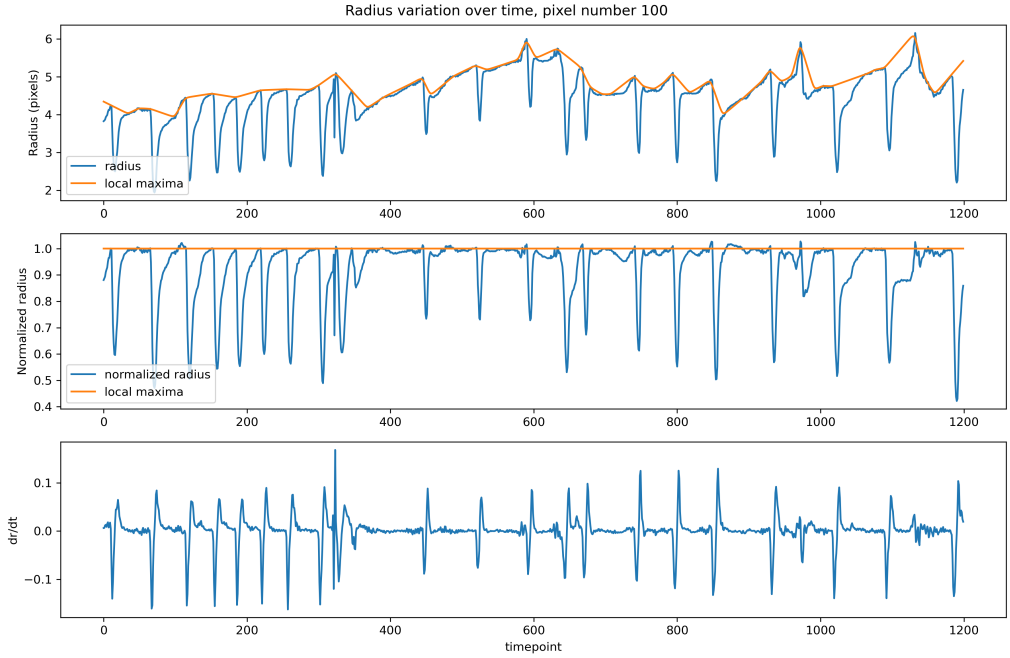
2.2 Processing

- Spatial registration
- Prediction masks (prediction > 0.5)
- Compute euclidean distance map (vessel radius)
- Get central line (skeletonize time-averaged prediction mask)



2.3 Analysis

- Get temporal radius variation for each pixel of the central line
- Normalize radius variation by local maxima
- Analyse derivative of normalized radius variation


Radius variation over time, pixel number 100
Radius (pixels)
radius
local maxima
Normalized radius
normalized radius
local maxima
dr/dt
timepoint