Automated Cardiac Realtime MRI Evaluation

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Motivation

- Univentricular hearts with rare and diverse anatomies
- Research in therapy and diagnosis
- Realtime MRI during spontaneous breathing to better understand physiology

Goal

Reliable automatic evaluation of the stroke volume in various breath phases

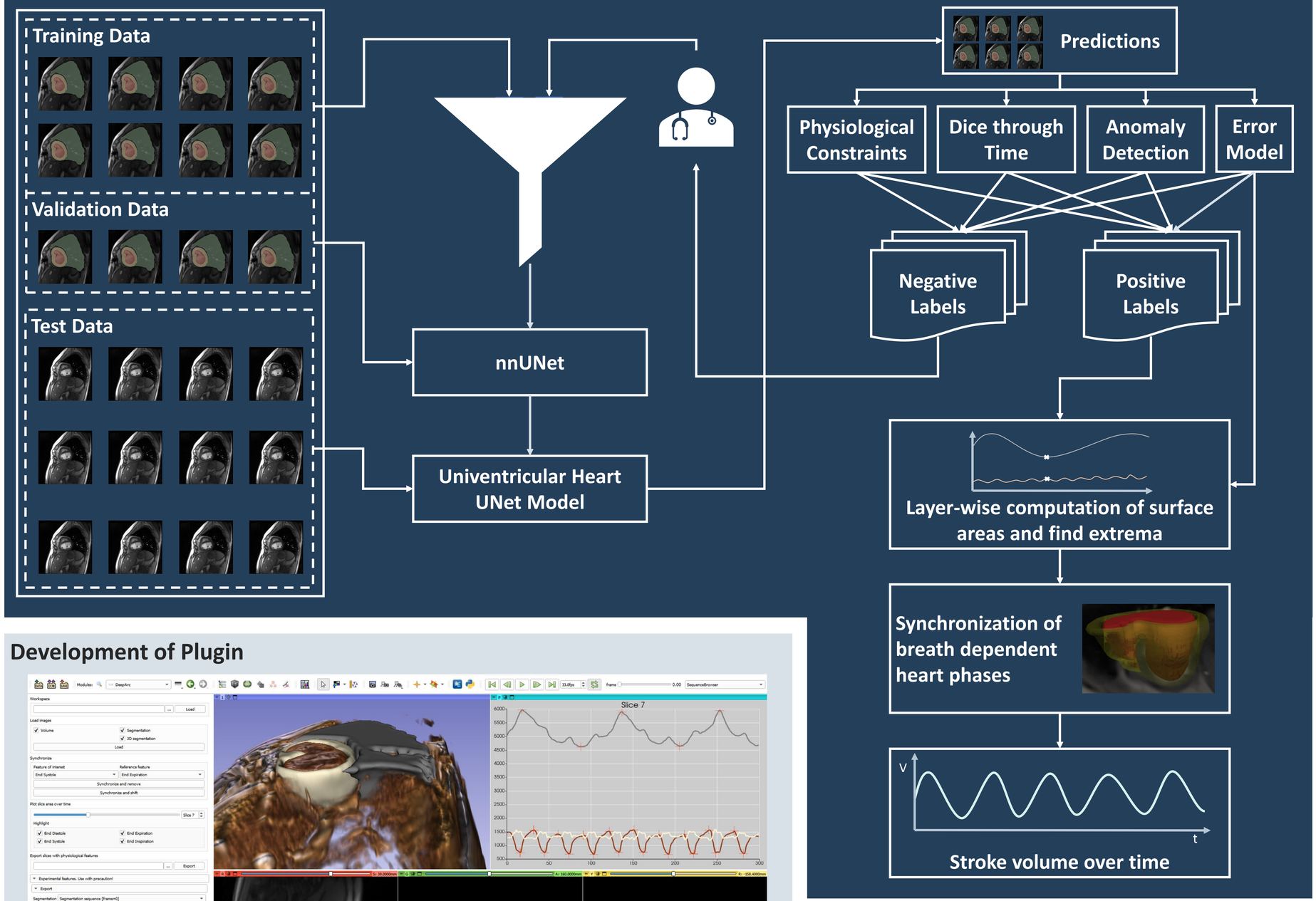
Challenges

- Limited amount and diversity of labeled data
- Various data origins (realtime MRI, CINE MRI)
- Evaluation pipeline based on images only
- Anomalies in images (e.g. due to metal defects)
- Heart and breath phases are not aligned

Methods

- Training of nnUNet[1] with 450 labeled images
  - Mostly CINE MRI
  - 37 different patients
- Uncertainty Analysis
  - Dice through time: Comparison of labels in sequential images (continuity expected)
  - Checking physiological constraints
  - Anomaly detection: Find outliers in image data and analyze label quality
  - Error model: Predict uncertainty of segmentation
- Synchronization
  - Find specific physiological time points to determine heart and breath phase in each layer
  - Assemble layer data into volumes of certain heart-breath-phase combinations
- Prediction Correction
  - Predictions are sorted into quality and type of uncertainty
  - A software is provided to easily correct the wrong labels

Workflow



Development of Plugin

[1] Isensee, F., Jaeger, P.F., Kohl, S.A.A. et al. nnU-Net: a self-configuring method for deep learning-based biomedical image segmentation. Nat Methods 18, 203–211 (2021).

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