Automated Cardiac Realtime MRI Evaluation

Motivation

- Univentricular hearts with rare and diverse anatomies
- Research in therapy and diagnosis

Institute for

DLR Software Technology

Realtime MRI during spontaneous breathing to better understand physiology

Goal

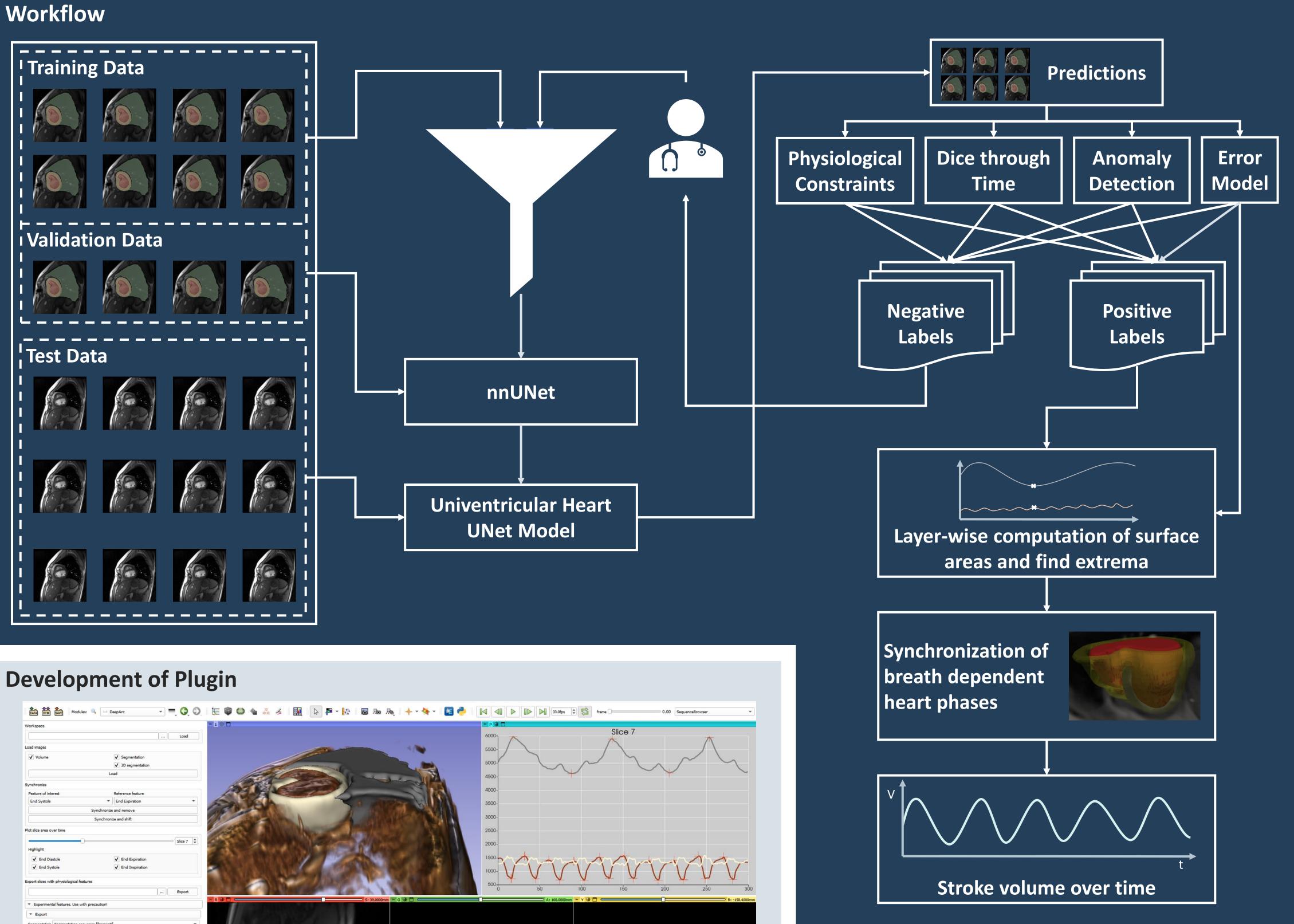
Reliable automatic evaluation of the stroke volume in various breath phases

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

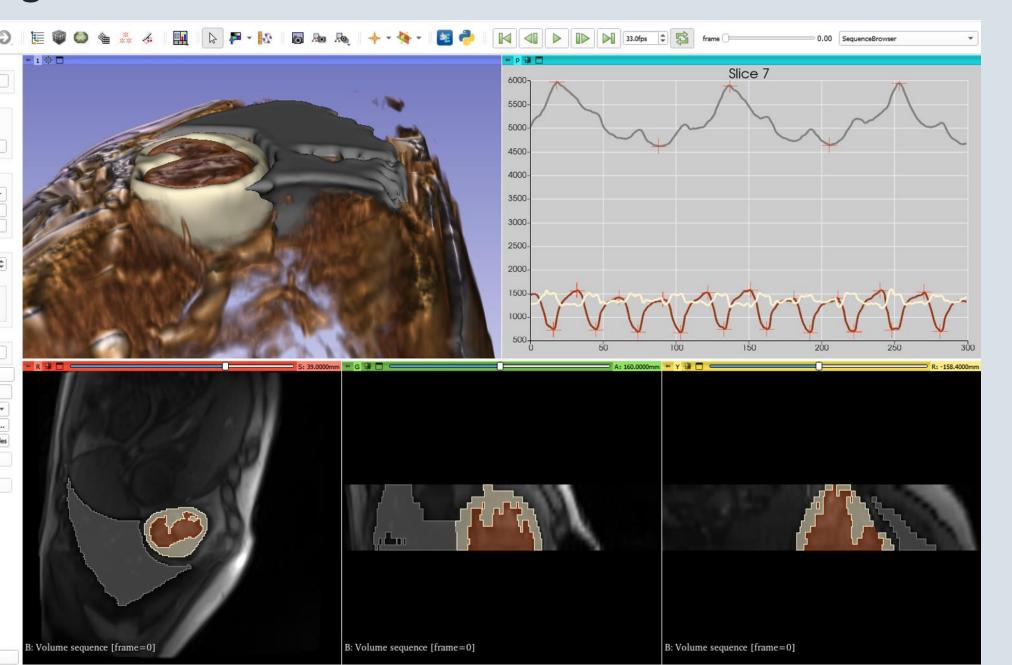
- Training of nnUNet^[1] with 450 labeled images
 - Mostly CINE MRI
 - 37 different patients
- Uncertainty Analysis
 - Dice through time: Comparison of labels in sequential images (continuity expected)
 - Checking physiological constraints
 - Anomaly detection: Find outliers in image data and analyze 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



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[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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