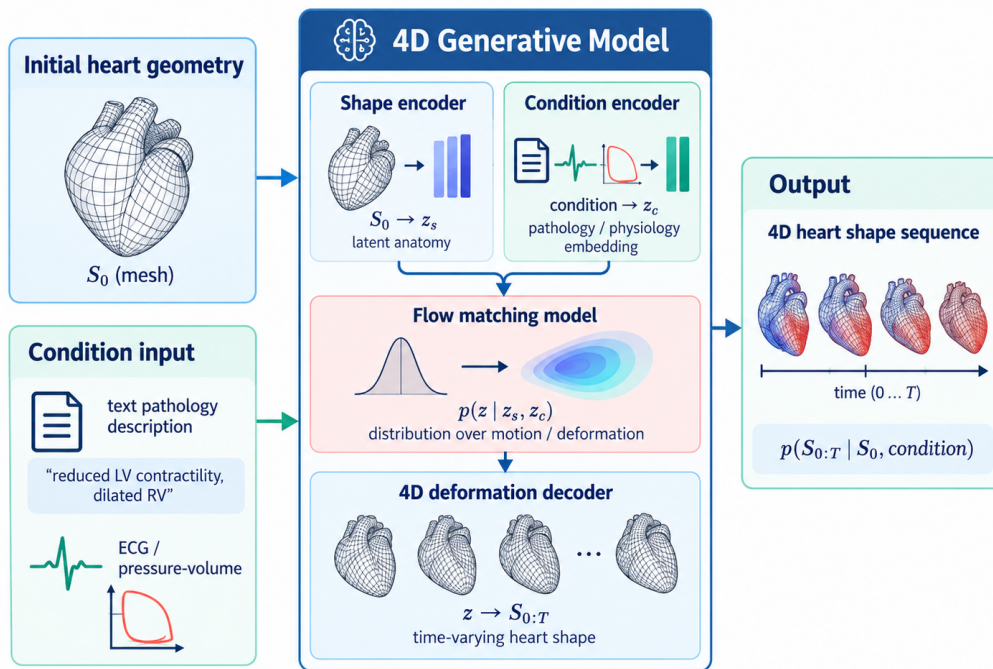


Pathology-Conditioned 4D Heart Shape Generation

Master Project/Thesis



Objective:

Recent methods such as CardiacFlow can generate time-varying heart shapes, while AnimateAnyMesh shows how text can guide the animation of a 3D mesh. However, these methods do not directly predict how an individual heart changes its motion under a specified pathological condition.

The objective of this thesis is to investigate a generative model that predicts the deformation of an initial 3D heart mesh during a heartbeat, conditioned on a pathology description such as "reduced left-ventricular contractility." The work will explore flow matching to generate plausible 4D mesh sequences, using synthetic electromechanical simulations for training and evaluation. Generated motion will be compared with simulated deformations, chamber-volume changes, and anatomical consistency.

Further Information:

- Q. Ma et al., "CardiacFlow: 3D+t Four-Chamber Cardiac Shape Completion and Generation via Flow Matching," *MICCAI*, 2025. [Paper]
- Z. Wu et al., "AnimateAnyMesh: A Feed-Forward 4D Foundation Model for Text-Driven Universal Mesh Animation," *ICCV*, 2025. [Paper]

Qualifications:

- Good Python programming skills and experience with deep learning frameworks such as PyTorch
- Interest in generative AI, 3D geometry, and medical applications
- Experience with mesh processing, generative models, or medical image analysis is advantageous

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