In silico Phantom Simulations for AI-powered 4D Cardiac Motion Estimation

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Outline

1. Motivation and background
2. Benchmark cardiac motion
    a. Introduction of a data repository of mouse-specific FE simulations of cardiac contraction
    b. The complete kinematic representation of the cardiac cycle through displacement vectors to estimate precise ground-truth motion
3. Synthetic image generation
    a. Create synthetic images and visualize slices over the complete cardiac cycle.
    b. Determine short- and long-axis representation of the biventricular heart.
4. Ground-truth image-based motion visualization
    a. Visualize different motion maps to represent the in- and through-plane displacements.
5. Problem 1: Synthetic phantom
    a. Discussion of image creation methods to replicate standard imaging systems
    b. Mesh-to-image rasterization to create a synthetic MRI
    c. Field II algorithm to simulate acoustic scattering and generate ultrasound Images
6. Problem 2: Image registration
    a. Discussion of the deformable image registration technique using the deformation field, assisting in tracking cardiac motion
    b. A simple torsion problem to estimate torsion in a cylinder
    c. Biventricular heart motion analysis
7. Problem 3: Image segmentation for heart reconstruction
    a. Introduction of image-based three-dimensional (3D) reconstruction to address segmentation errors using Signed Distance Functions (SDFs)
    b. Simple machine-learning-enabled subject-specific cardiac reconstruction