Toward the Patient-Specific Isogeometric Analysis of Sustained Ventricular Tachycardias

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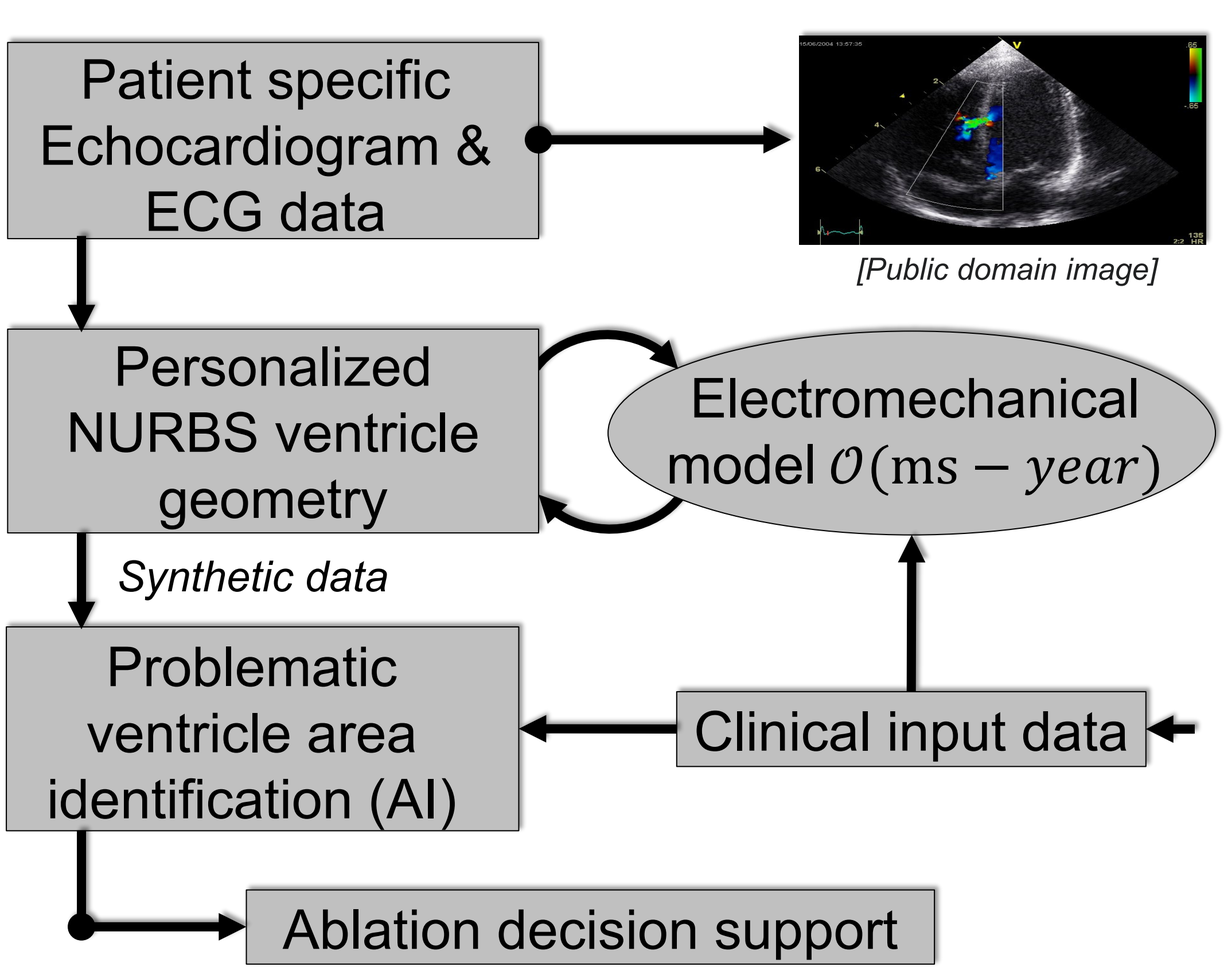
Part of the NWO HTSM project Computational-Model-Based Decision Support for Patients at Risk for Sustained Ventricular Tachycardias

Motivation and objective

Computer simulations provide information that can be used by clinicians to support decision-making regarding the treatment of Ventricular Tachycardias (VTs). It is the goal of this project to *develop efficient and robust models that can be integrated into the clinical workflow*.

Simulation workflow

Our simulation framework combines the *Isogeometric Analysis (IGA)* simulation paradigm [1] with image recognition techniques to obtain patient-specific computer models.



Isogeometric analysis

Simulations will be performed directly on a Non-Uniform Rational Basis Spline (NURBS) model, without the need for expensive geometry cleanup and meshing operations. The control points (CPS) of the NURBS model will be fit to echocardiogram scan data.

[1] T. J. R. Hughes, J. A. Cottrell, and Y. Bazilevs (2005). "Isogeometric analysis: CAD, finite elements, NURBS, exact geometry and mesh refinement". *Comput. Methods in Appl. Mech. Eng.* **194.39**, 4135 - 4195.

[2] P. H. M. Bovendeerd, W. Kroon, and T. Delhaas (2009). "Determinants of left ventricular shear strain". *Am. J. Physiol. Heart. Circ. Physiol*. **297.3**, H1058-H1068.

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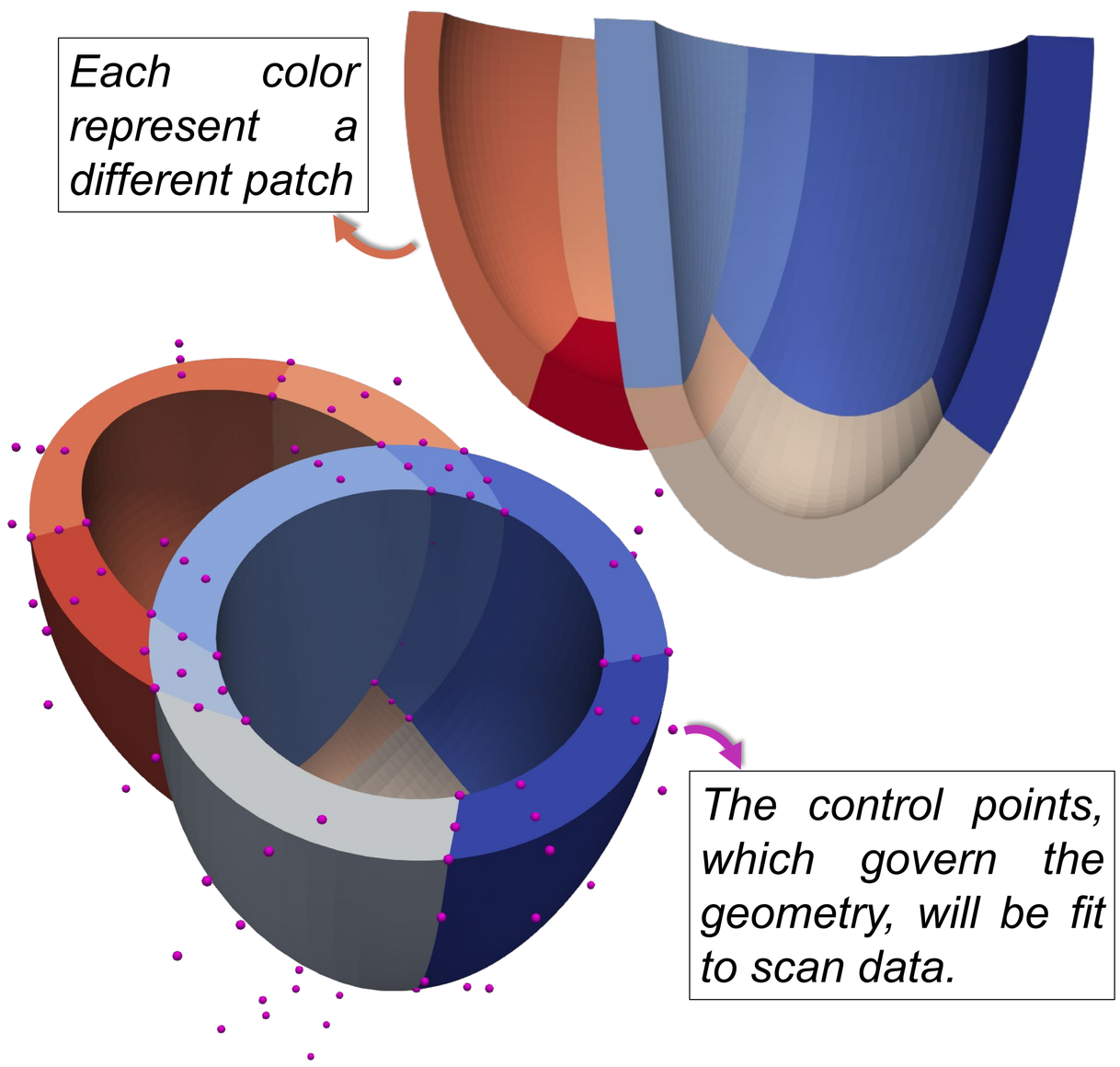
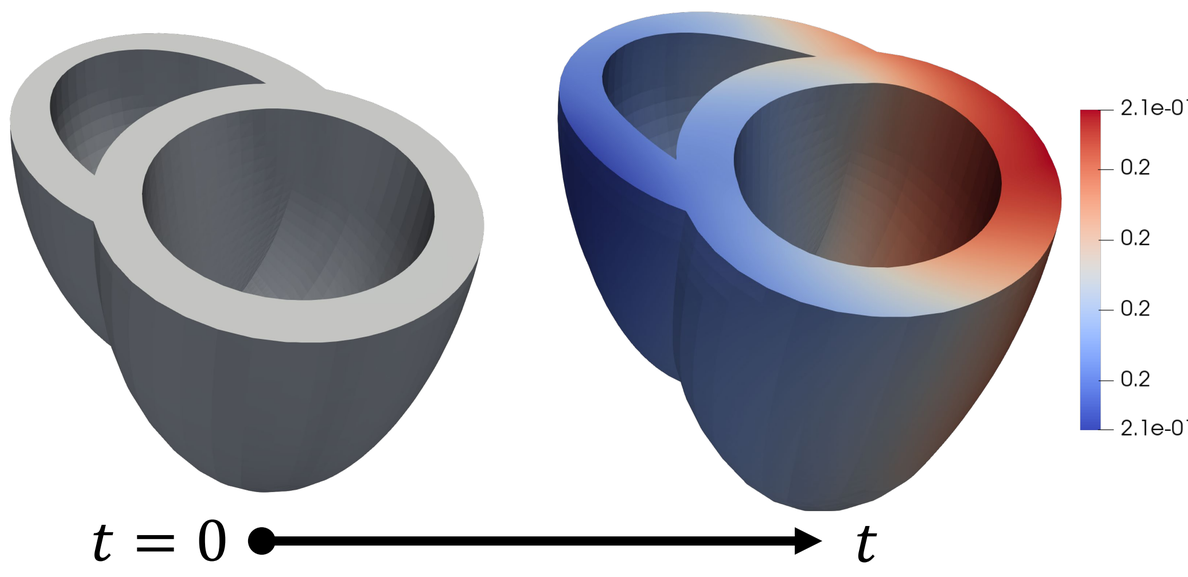
Idealized Bi-ventricle NURBS geometry



Preliminary results

Displacement results, model based on Ref. [2].



Contraction at constant cavity pressure, 264 cps.

Project outlook

IGA has the potential to give robust geometry and analysis models in the considered scenario of limited input data. Future project steps focus on the automation of image-based geometry reconstruction, while extending the model validation and clinical-integration.

Project progress