Multi-Scale Modeling of Single Ventricle Hearts for Clinical Decision Support – An overview

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Dedicated to improving human health through international efforts to combat cardiovascular disease.

http://www.fondationleducq.org/
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The Network


Local Impact, National Influence, Global Reach
Multi-Scale Modeling of Single Ventricle Hearts for Clinical Decision Support

**Integration** of expertise in pediatric cardiology, surgery, imaging, engineering, and computer science

**Development** of a modeling system that can assist and support the clinical management of complex congenital heart disease (CHD).

**Simulation** of virtual operations using patient-specific data with a modeling strategy including *physiologic changes over time* that could alter initial treatment strategies.
The surgical and medical management of children with HLHS is **challenging**, and each child’s unique anatomy and physiology requires an **individualistic approach**.

Important parameters that regulate pressure and flow, such as pulmonary vascular resistance, **dramatically change** between birth and adulthood.

A further complicating issue is that there are **different operations for each Stage**, all intended to achieve the same circulatory physiology, but with dissimilar hemodynamics, and potentially different clinical outcomes.
The Project

Model Construction -> Operative Reconstruction
Model Construction -> Surgical Decision
Model Construction -> Clinical Guidance
Model Construction -> Post-operative Management
Model Construction -> Model Validation

Model Validation -> Model Validation
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http://modelingventricle.clemson.edu/
The goal of the software product line strategy is to establish a production capability that can

- rapidly and accurately produce multiple products within a well-defined scope
- achieve specific business goals that can be affected by the way the organization produces products.

We will develop a set of products suitable for the range of computer resources available to surgeons around the world.
The payoff

Initiating a software product line strategy requires some amount of up-front investment although it can be minimal. If the commonality is sufficiently high, payback can happen after a relatively small number of products.

Many organizations have reached the payoff point.
Product Line organization

Core asset team

Product team

Configuration management

Software architecture

Asset source

Open source

Domain organization

Reference architecture

Parent organization

Customer

requirements

Product management

Strategic partner
Structured Intuitive Model of Product Line Economics
Supports cost/benefit analysis of a product line

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\text{nbrBenefit} = \sum_{j=1}^{n} B_{\text{ben}_j} - (C_{\text{org}}() + C_{\text{cab}}()) + \sum_{i=1}^{n} (C_{\text{unique}}(\text{product}_i) + C_{\text{reuse}}(\text{product}_i))
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