AN INTERACTIVE CLINICAL INTERFACE FOR MR IMAGE-BASED COMPUTATIONAL MECHANICS MODELING OF THE HUMAN CARDIOVASCULAR SYSTEM

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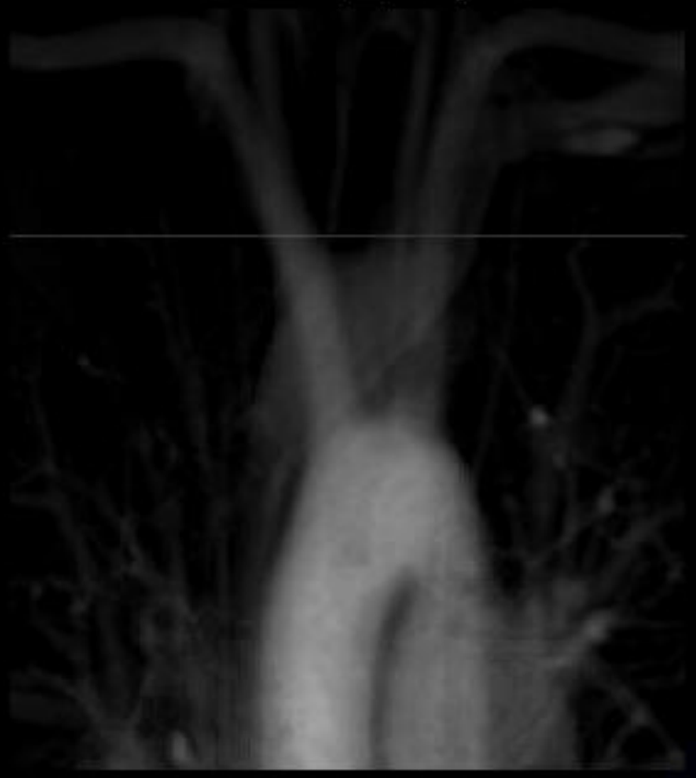
Requirements

Clinical modeling is special

- individual variation patient specific modeling
- save patient's life accurate modeling
- time is severely limited quick modeling



Accurate Modeling

- volumetric image based modeling
- medical images contains noise and artifacts
- hard to construct automatically
- needs experience and expertise

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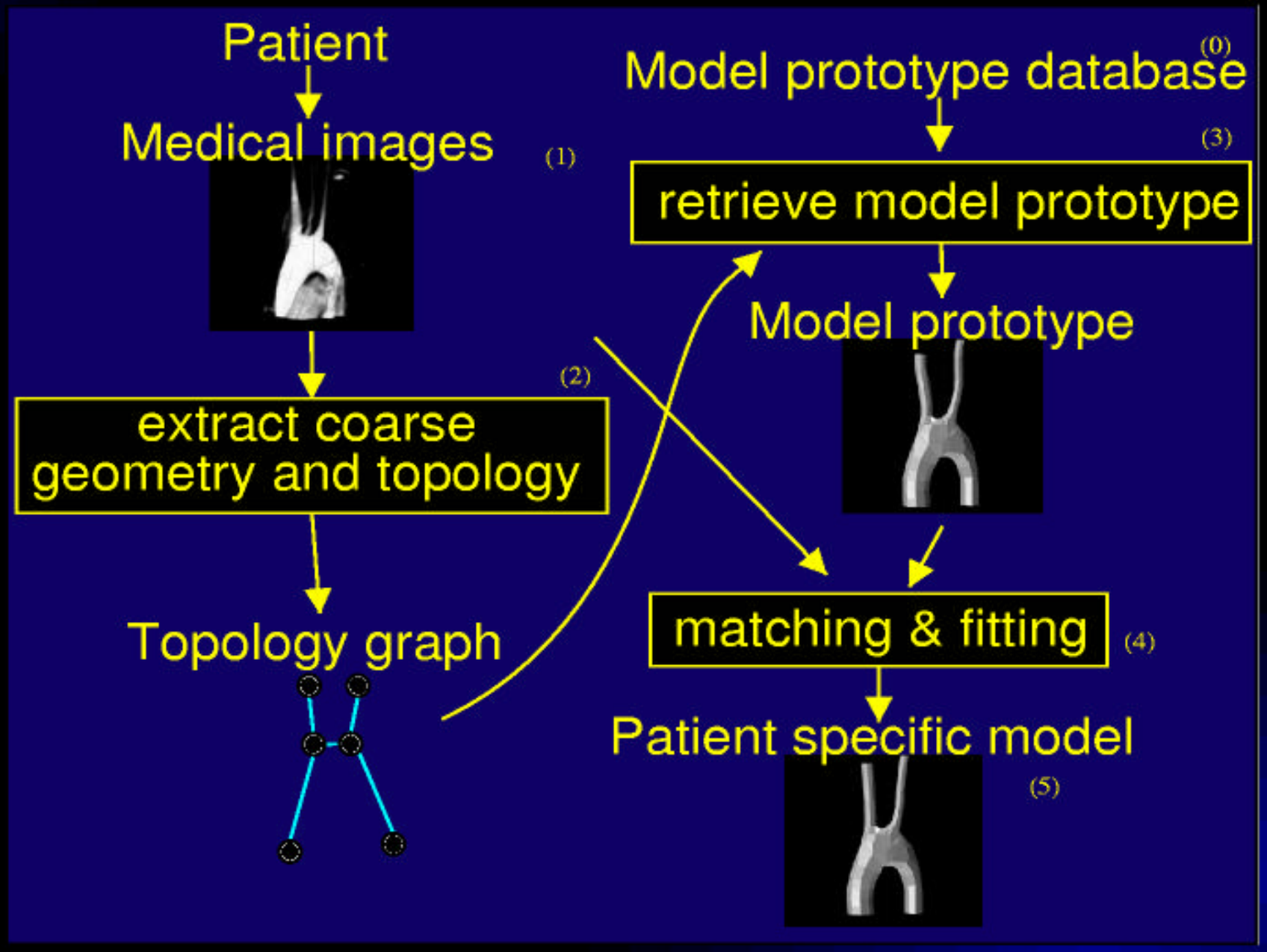
interactive modeling system is needed.

Quick Modeling

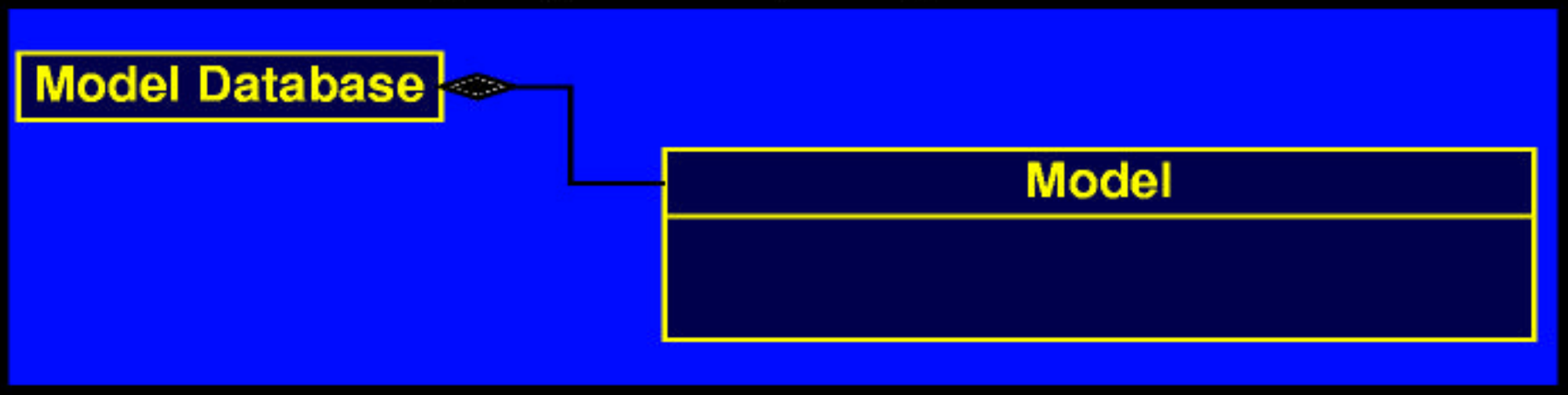
- quick modeling using preconstructed prototype.



Model and Model Database

"Model" in Database includes

- original medical image data
- computational grids
- pre-calculated physical properties



Quick Modeling

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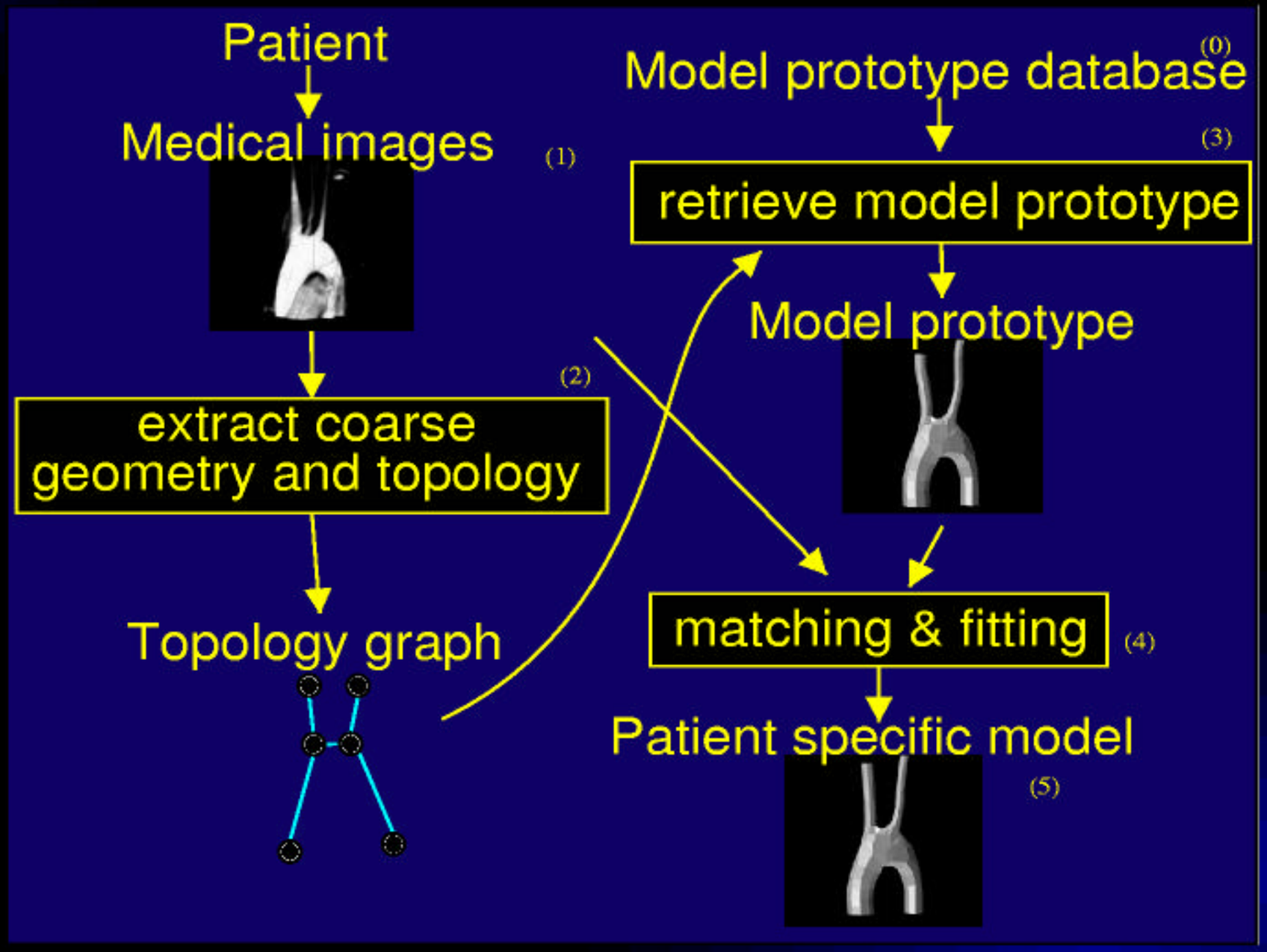
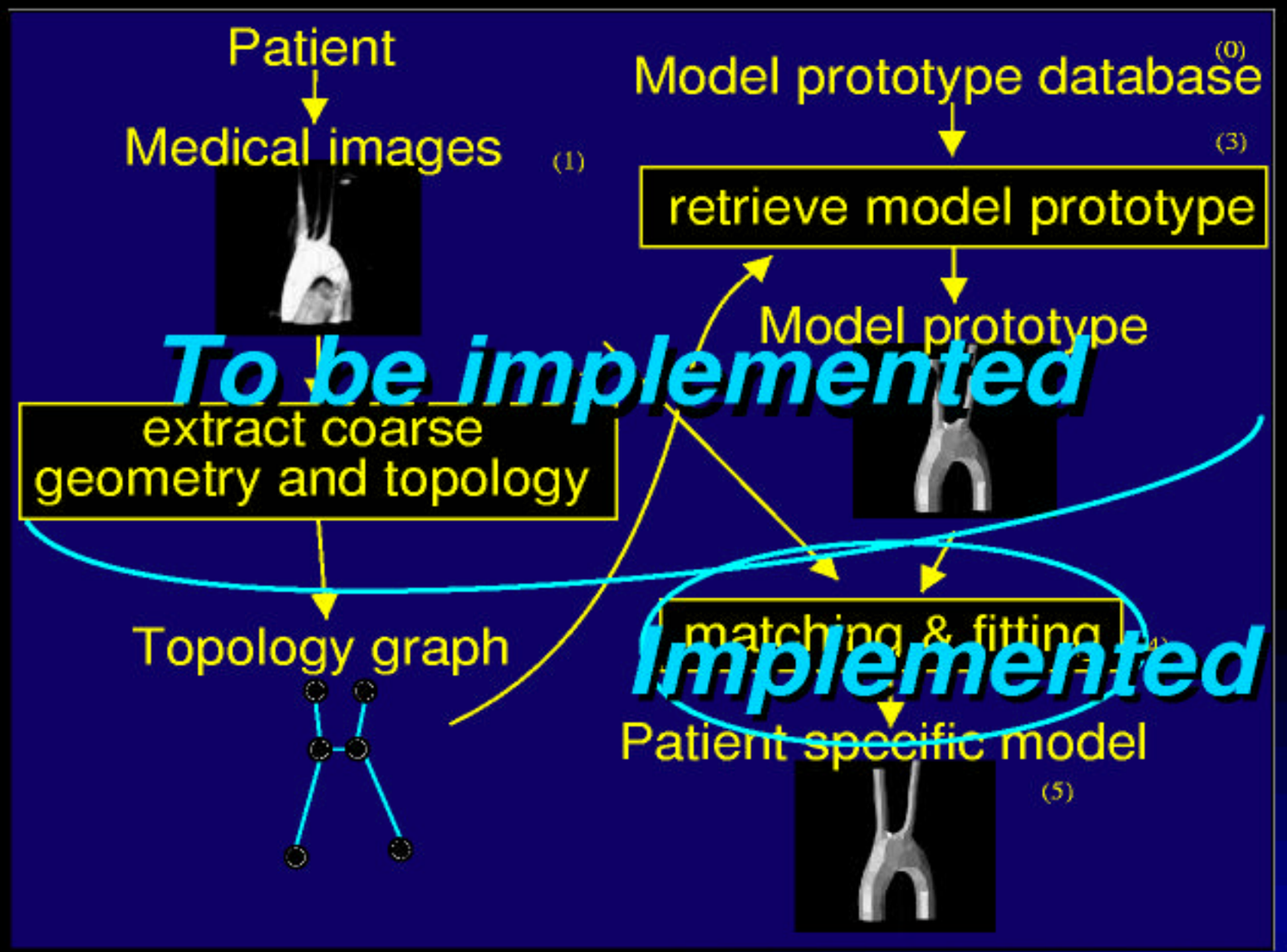


Malmodeler (2000 ASME IMECE)

- real time volume rendering
- mesh in same view
- Loop subdivision
- multi-resolution mesh editing

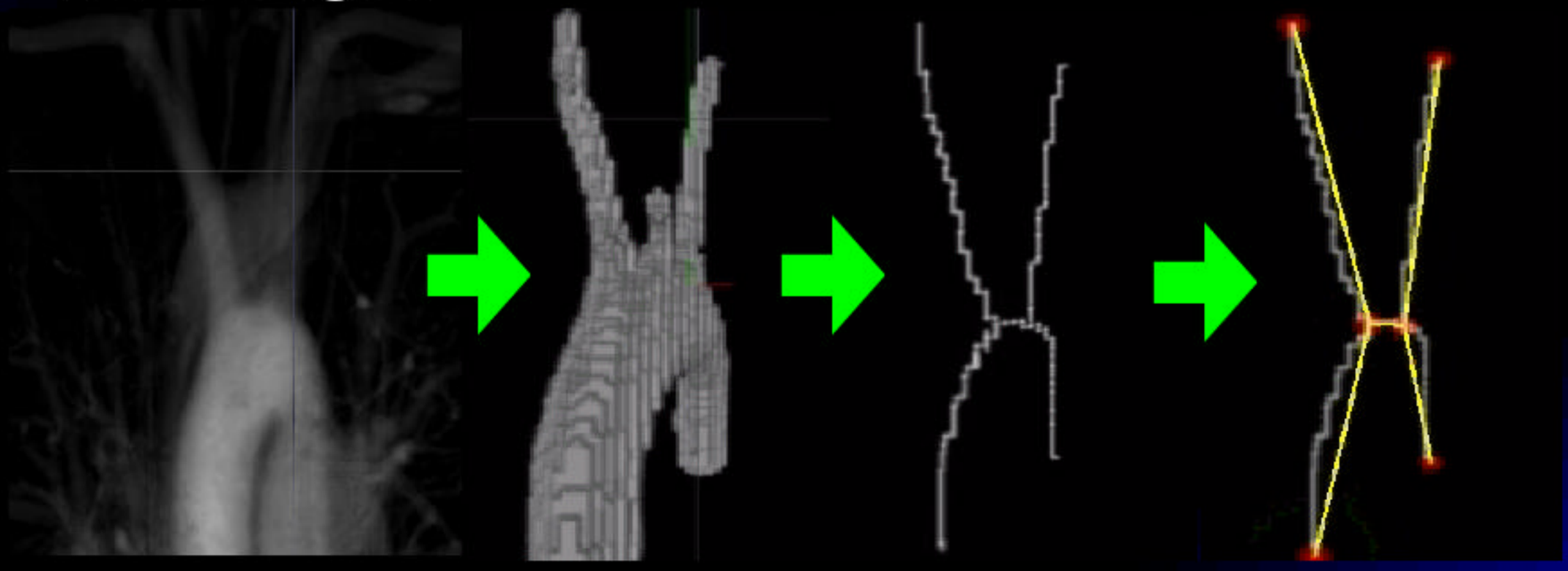
What's Left?

- Topology estimation
- DBMS with topology matching
- Model database
- System integration & UI



Topology Estimation

- Make binary image
- Skeltonize
- Trace edges



Making Binary Image

- accuracy is not very important
- speed is very important

Skeltonization

- make crude centerlines
- delete pixels from boundary

Edge Tracing

- determine connection between nodes
- trace each edges pixel by pixel

Model Database

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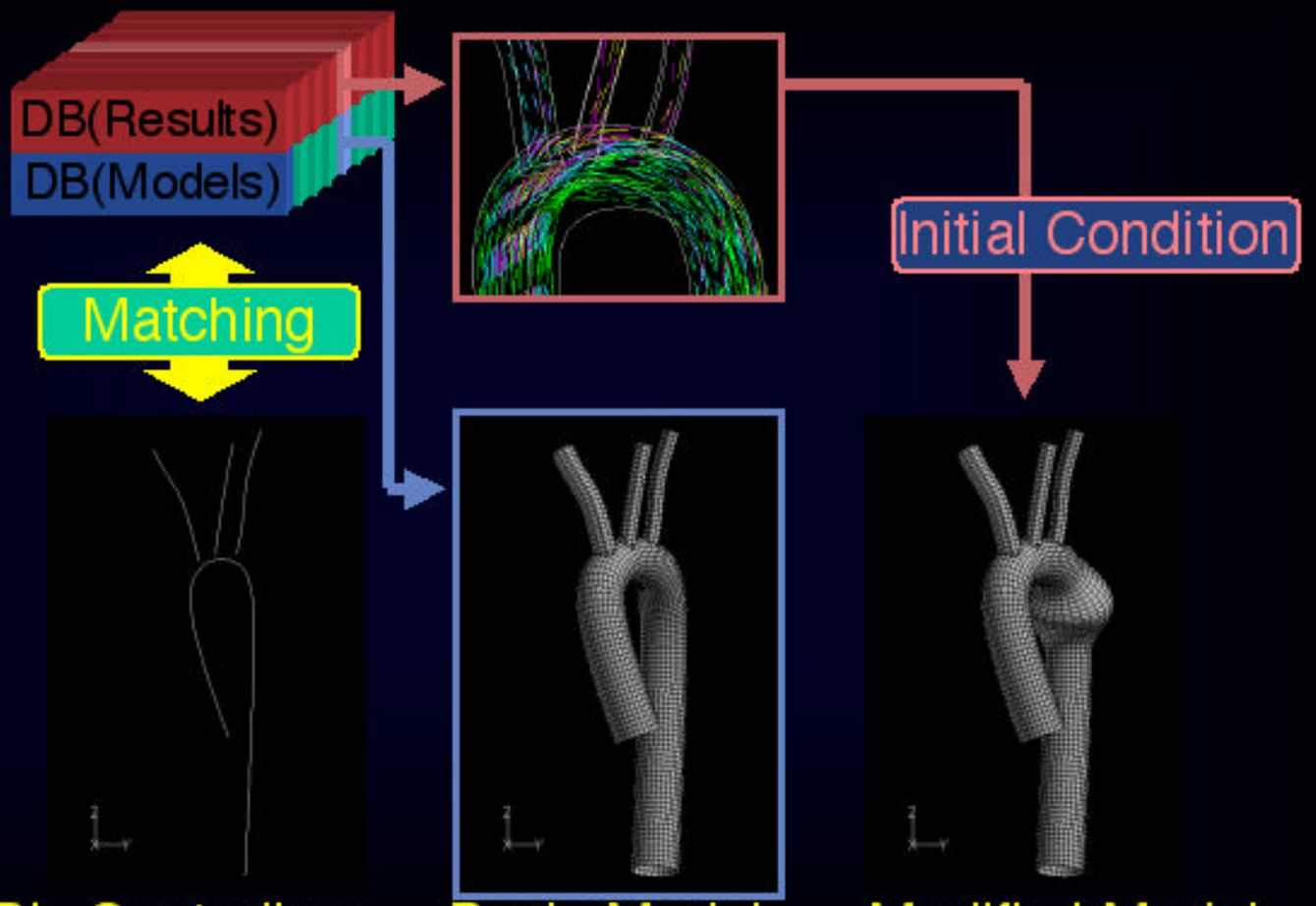
Database of Images, Topology, Models and Pre-Computed Flows



Physiological Flow Studies Laboratory

Centerline Based Grid Definition

- easy to modify by hands
- easy to generate a structured grid

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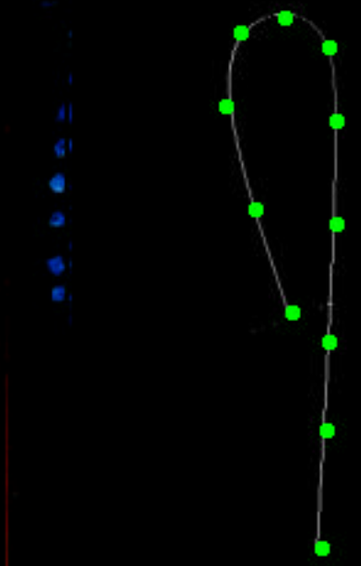
Centerline Based Grid Definition

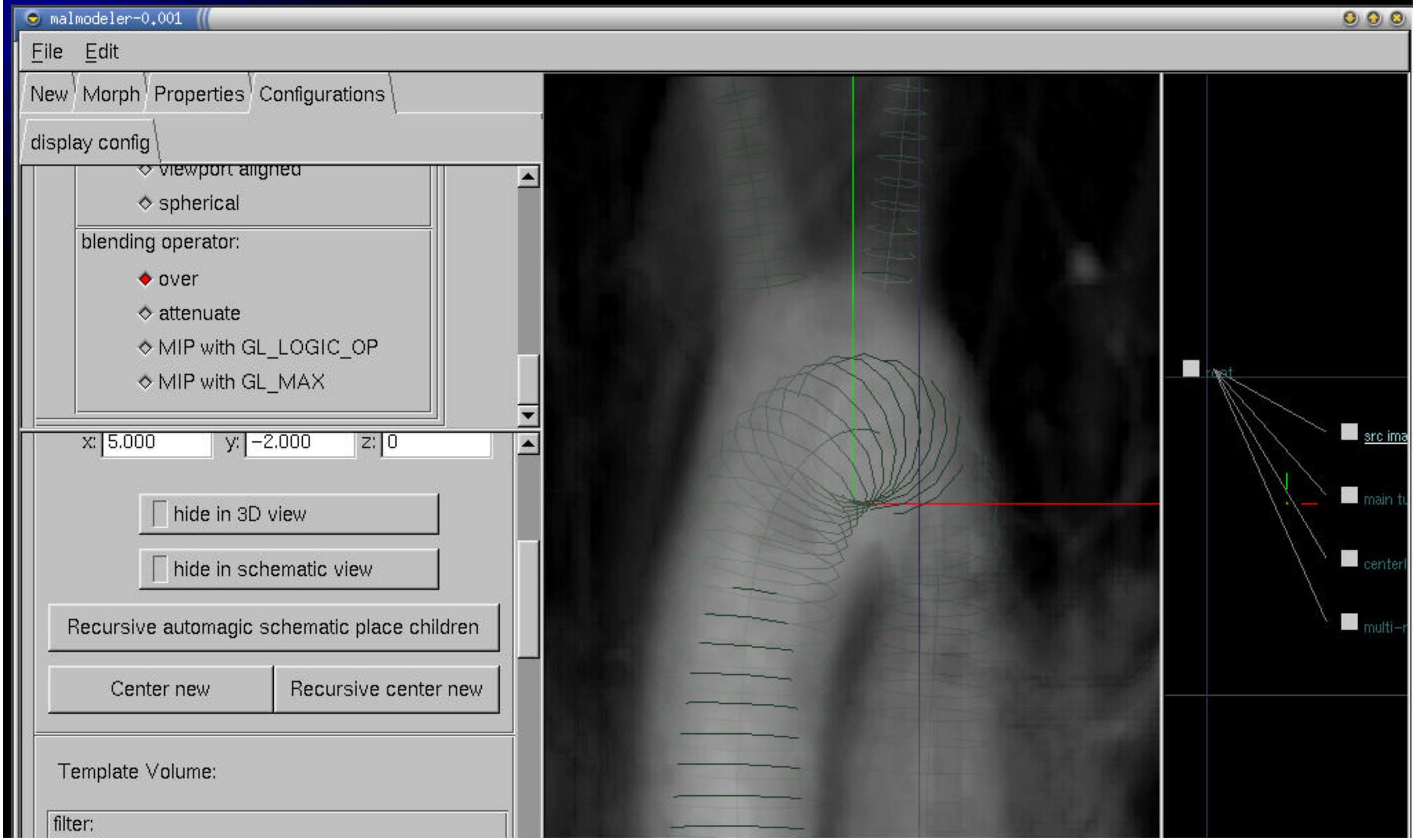


Extracting of the Centerline

Curve-fitting to a cubic spline

Definition of the Grids on the Normal Plane

System Integration and User Interface



Summary

- quick and accurate modeling
- using pre-constructed model database

- topology estimation

Future Works

- database management system with topology matching
- model database
- system integration and user interface
- validation