Development of Interactive Modeling System for the Computational Biomechanics Simulation using Medical Imaging Data

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Introduction

- Patient specific and realistic models are needed.
- Modeling based on volumetric images.
- Medical imaging data contains various artifacts.
- It is hard to construct a geometric model automatically.
Goal

- Develop a novel modeling system to construct geometric models from medical imaging data interactively with directly using the operator's anatomical knowledge and ability of space perception.
- The system can render volumetric images acquired with MRI.
- Users can directly manipulate the geometric model rendered over the volumetric image.
Geometric objects

- MM_AppWindow
  - _model
  - _tools
  - _controllers
  - _views
- MM_Model
  - _root
- MM_Tool
- MM_Controller
- MM_View
- MM_View_3DWindow
- MM_View_SchematicView
- MM_GeometricObject
- MM_GO_Composite
  - _children
- MM_GO_TemplateVolume
- MM_GO_ControlPoint
- MM_GO_PolygonalMesh
Device independent input
Realtime volume rendering

The system uses volume slicing:
- simulates traditional ray casting using texture mapping and alpha blending
- can produce a projected image at interactive frame rate with dedicated texture mapping hardware
Multiresolution mesh editing
Development environments

- Hardwares
  - Debian GNU/Linux PC + Millennium G400
  - Debian GNU/Linux PC + Oxygen VX1
  - SGI ONYX2 Reality Monster + Immersive Work Bench

- Softwares
  - GNU C++ Compiler\textregistered MIPS Pro C++ Compiler
  - Mesa + Utah-GLX\textregistered OpenGL
  - FLTK
  - libsigc++
Results
- support 6 DOF input device
- support haptic rendering
- automatic segmentation
- mesh generation