Medical simulators

The Alexandra Institute

Computer graphics lab

Karsten Østergaard Noe
Medical applications at the Alexandra Institute

- Pervasive healthcare lab
  - Information Technology as a pervasive healthcare tool
    - more efficient examination, treatment and follow-up
    - bring computer power into all levels of the healthcare system
  - Methods
    - user-driven innovation
    - interdisciplinary collaboration
  - Many partners
    - Commercial
    - Research institutions
    - public health institutions

www.alexandra.dk/uk/labs/Pages/Pervasive-Healthcare-lab.aspx
Medical applications at the Alexandra Institute

• Computer graphics lab
  – Surgical simulators
  – Medical visualization

  – Collaboration with various public health institutions:
    • Department of Cardiac Thoracic and Vascular Surgery, Aarhus University Hospital, DK
    • Department of Paediatric Cardiology, University of Tübingen, Germany
    • Division of Imaging Sciences, Kings College London
    • The MR-center, Aarhus University Hospital, DK
    • Department of Oncology, Aarhus University Hospital, DK
    • Aarhus School of Dentistry, Aarhus University, DK
    • Dept. of Otolaryngology, Danish National Hospital (Rigshospitalet), dk
Three examples

- Visible Ear Simulator
- Cardiac Surgery Simulator
- Anatomy Atlas in stereo 3D
Two uses for surgical simulators

- Practice / Training of surgical skills
- Pre-operative planning
Training of surgical skills

• Current training methods
  – Artificial materials
  – Animals
  – Bodies from deceased humans
  – On patients!
    • See one – do one – teach one

• Training using simulators
  – No time pressure
  – Infinite number of tries
  – Training of rare cases
  – Failing is allowed!
Pre-operative planning

- Pre-operative planning
  - Patient specific morphology
  - Review procedure beforehand
  - Better navigation in 3D

Picture from "New York Emergency Room RN"
Cardiac surgery simulator
From MRI to 3D grid of springs

- Physics simulation done on the GPU
Visible Ear Simulator
Without simulator

- Drilling practice
  - Temporal bones donated to science
  - Temporal bone casts of artificial materials
Visible Ear Simulator

- Simulation of bone drilling into temporal bone
- Realistic volume rendering with transparency
- Accurate color reproduction
- Haptic feedback

- Free download (http://ves.cg.alexandra.dk/)
Cryosection

Volume rendering on the GPU
• Funding kindly provided by the Oticon Foundation
• Entire anatomical bone volume included
  – Bone volume divided into blocks for more compact storage
  – Higher resolution possible
• Other segments as triangle surfaces
  – Allows simulation of interaction and deformation
• Improved visual appearance
  – Various realtime techniques used
• Support for clinical validation (Ph.d.- project)
Thank you for your attention!
Anatomical Atlas

- Department of Oncology, Aarhus University Hospital
- Stereo 3D Vision
- Volume rendering of Visible Human data set
- “Peel-off-organs”