# Virtual Reality-Based Medical Training and Testing

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## VR – Based Medical Training It's hard, why bother?

- Flexibility
- Reuse
- Objective and autonomous measures

(Augmenting normal faculty student interaction)

## Objectives

Describe the state of virtual reality (VR) simulation technology in different disciplines;

Discuss the benefits of 3D technology, including haptics, in simulated scenarios;

Describe the applicability of simulation to the evaluation of the post-licensure physician in different medical specialties.

## Some points on the State-of-the-Art of Virtual Reality (VR) Simulation in Different Disciplines

- Generally Combine
  - 3-D stereo graphics (often collocated)
  - High fidelity haptics (often two)
  - High fidelity models
  - High performance computing
  - Software that estimates the physiology and physics of the scenario, including interaction

## Stereo Display

- Whatever gets each eye to see the appropriate image pair:

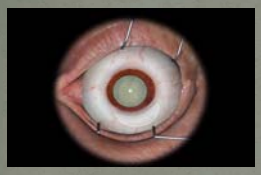



## Haptic Display






## Models



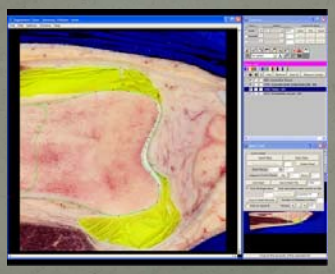

## Models

- Volumetric data gathering
- Segmentation and classification
- Produce polygonal surface models
- Texture-map the models
- Produce tetrahedral models
- Give them properties – mechanical, acoustical, electrical, etc.

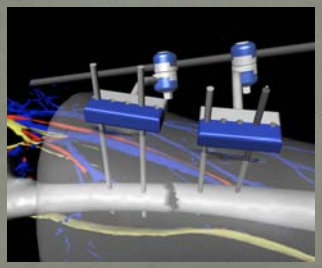
## Cryosectioning

## Segmentation and Classification

- Why surface splines?

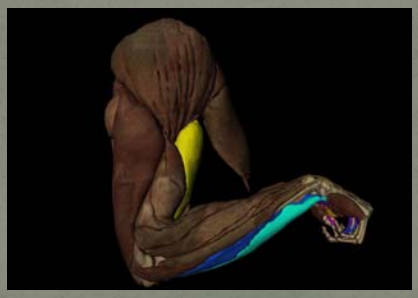


## Polygonal models

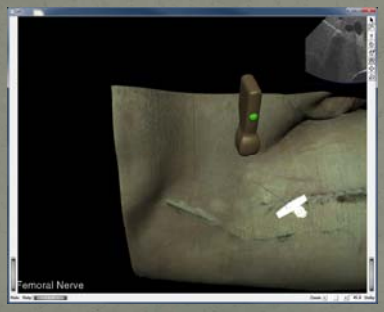


## Texture-Mapped Polygonal Models

## Tetrahedra Bring Posture Changes



## Associating Properties with Volume




## Computer Power - GPUs

Compute Unified Device Architecture (CUDA)
http://www.nvidia.com/object/cuda_home_new.html

If you can parallelize your code, having a few thousand processors at your bidding is a game changer.

## Some Handy Things to be Able to Do

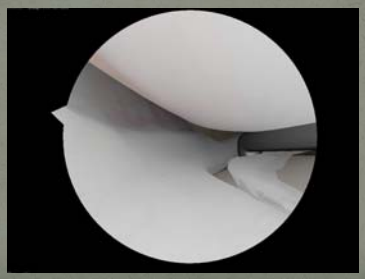
- Palpate
- Insert needles
- Cut and tear

In a volumetrically defined virtual patient that can:

- Change Posture
- Display a pulse
- Display subcutaneous boney landmarks
- Display ultrasound and fluoroscopy
- Bleed

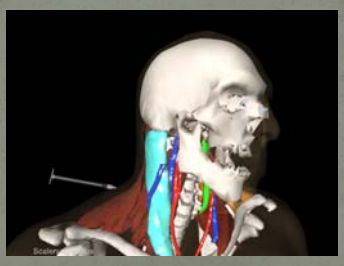
## Building virtual tools

- If you can palpate it



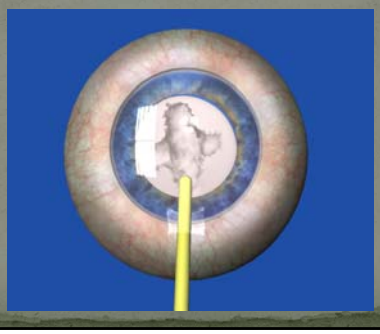
## Building virtual tools

- If you can put a needle in it

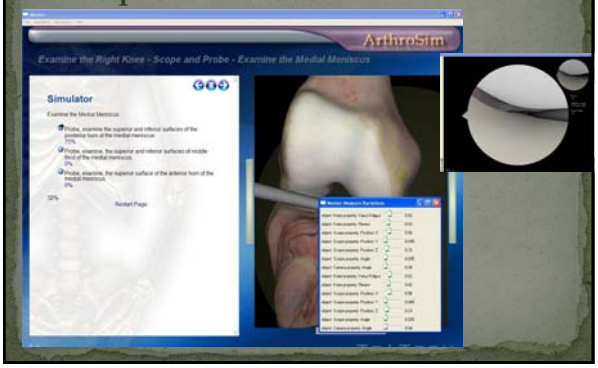


## Building virtual tools

- If you can cut it and tear it



## Examples of Measures




## Measuring proficiency

- Training Vs. Testing
  - When you train someone, it is reasonable to expect that they perform according to the training. Simply constraining the measures to be optimal within some tolerance will almost always suffice.
  - To gauge proficiency, independent of training, enters the domain of judgment.
- With VR, all is known. However, not all is understood.

## Thank You