

The Simulation Group @ CIMIT

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CIMIT Simulation Group / Harvard Medical School

<http://simcen.usuhs.mil/miccai2003>

CIMIT

- CIMIT (Center for Integration of Medicine & Innovative Technology) is a non-profit consortium of world-leading academic and research institutions:
 - Massachusetts General Hospital
 - Brigham and Women's Hospital
 - Massachusetts Institute of Technology
 - Draper Laboratory.
- CIMIT's mission is to improve patient care by bringing together scientists, engineers, and clinicians to catalyze development of innovative technology, emphasizing minimally invasive diagnosis and therapy.

<http://www.cimit.org>

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The Simulation Group

- The team: 7 people of mixed backgrounds
- Main focus: medical simulation
- Emphasis on:
 - soft tissue modeling
 - validation / metrics
 - systems integration
 - applications



<http://www.medicalsim.org>

Past & current projects

- ICTS: Interventional Cardiology Training System
- VIRGIL: Chest Trauma Training System
- CELTS: Computer Enhanced Laparoscopic Training System
- Interventional Neuroradiology Training System
- CAML: Generic Framework for Medical Simulation
- Real-time Soft Tissue Modeling
 - Linear Elastic Behavior using FEM (hepatic surgery)
 - Spring Mass Models (eye surgery)
 - New approaches for non-linear elasticity & more complex behavior
- Soft Tissue Properties Measurement Devices:
 - Tempest, Rosa
- Truth Cube

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Past & current projects

- **ICTS: Interventional Cardiology Training System**
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ICTS Architecture



Multi-axial haptics device

Realistic physical modeling
Real-time multi-processor system



High-fidelity visual feedback

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ICTS Today

- Sold by Mentice AB and named VIST®
- Eight systems installed at the *Guidant European Cardiac and Vascular Institute* in Brussels
- New center created in Tokyo in 2003
- About 4,000 physicians trained



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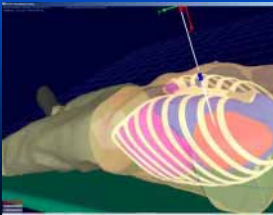
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VIRGIL®

- Chest Trauma Training System
- Hybrid mannequin / computer-based simulator
- Ready for battlefield training



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Virgil Video Clip (news7)

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CELTS

- Training system for technical skills
- Incorporate new metrics for accurate skills assessment
- Integrates a task-independent standardized scoring system



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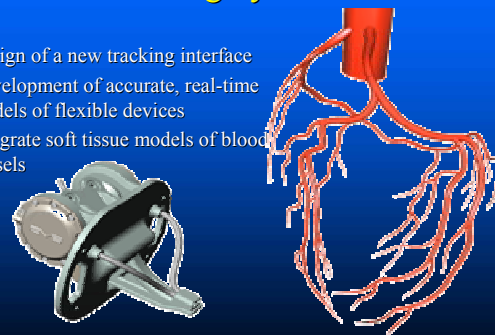
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Interventional Neuroradiology Training System

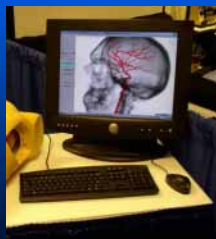
- Design of a new tracking interface
- Development of accurate, real-time models of flexible devices
- Integrate soft tissue models of blood vessels



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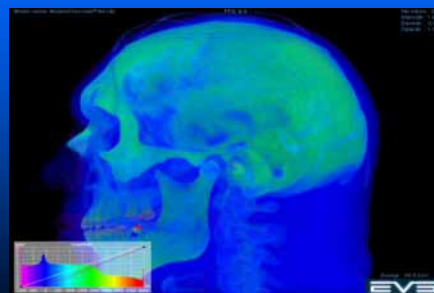
Interventional Neuroradiology Training System

- Design of a new tracking interface
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Interventional Neuroradiology Training System



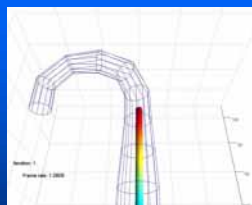
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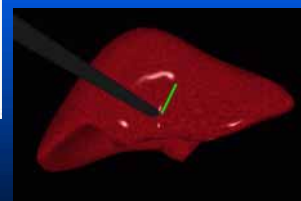
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Real-Time Deformation



Real-time deformation of a catheter navigating through a vessel based on non-linear FEM and quadratic programming



Real-time volumetric deformation based on FEM and linear elasticity

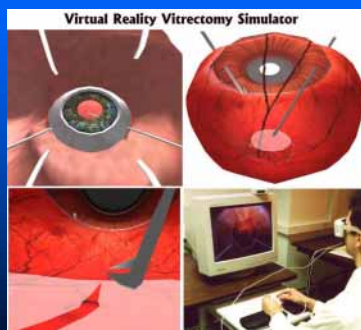
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Eye Surgery Simulator



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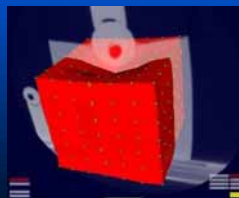
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Soft-Tissue Modeling

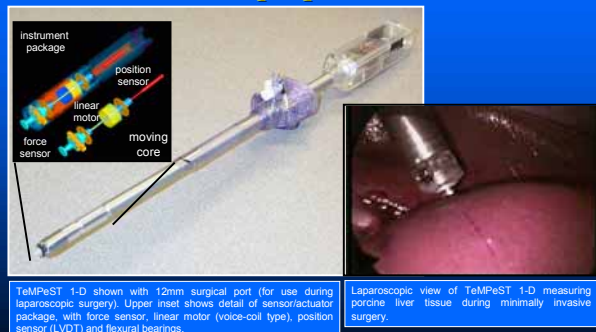
- Four-year research program
- Collaboration with Harvard Biorobotics Lab
- *First phase:* measurement of mechanical properties of soft tissue in solid organs, *in vivo*
- *Second phase:* develop real-time deformable models of soft tissue and solid organs



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TeMPeST device for measuring soft tissue properties *in vivo*



TeMPeST 1-D shown with 12mm surgical port (for use during laparoscopic surgery). Upper inset shows detail of sensor/actuator package, with force sensor, linear motor (voice-coil type), position sensor (LVDT) and flexural bearings.

Laparoscopic view of TeMPeST 1-D measuring porcine liver tissue during minimally invasive surgery.

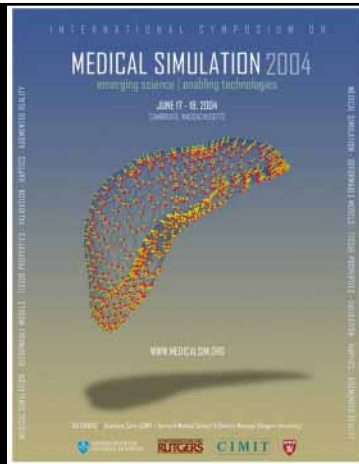
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“Truth Cube”

- Validate real-time (and non real-time) soft tissue deformation algorithms



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Contact Information

- Web sites
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 - www.truthcube.org
- Email:
 - Stephane Cotin: cotin.stephane@mgh.harvard.edu
 - Steven Dawson: dawson.steven@mgh.harvard.edu
- Workshop on medical simulation
 - When: June 17-18, 2004
 - Where: Boston

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United States Department of Defense*

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