Robotic Surgery and Surgical Simulation

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- Leading research in exploration of telesurgery and applying simulation devices to surgical education
- CTO for U.S. Army Simulation, Training and Instrumentation (PEO STRI)
- CTO and Vice President at Titan Systems Inc.
- Research Scientist for Texas A&M University
- Serves as a Graduate Faculty Scholar at the University of Central Florida
- Visiting Lecturer at Georgia Institute of Technology
- Faculty at the Florida Hospital College of Health Sciences

- Published 5 Books (Chapter contributions to 10 books)
- 150 technical and management papers

- B.S. in Applied Mathematics
- M.S. in Statistics
- Master’s and Doctorate in Business Administration
- Ph.D. in Computer Science.

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- Technical, Social and Economic importance of simulation and gaming
- Focus on techniques, tools and technologies
- Historical summary and future possibilities
- Explores and contrasts Military and Commercial gaming evolutions

The traditional Halstedian apprenticeship model of 'see one, do one, teach one' is no longer adequate to train surgeons, since good laparoscopic skills cannot be developed by merely watching an expert." - A. Pearson, M.D.

"There is no excuse for the surgeon to learn on the patient." - William Mayo, 1927

Dr. Smith’s Book proposes 4 hypotheses:
1. Virtual Reality and gaming can reduce costs for surgical training
2. VR and gaming can improve repetitive practice to assess patient symptoms
3. VR and game training environments can reduce training times (for equal skill)
4. VR and gaming can reduce medical errors

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Florida Hospital

- 8 Campus Hospital System in Orlando, Florida
- 34 Regional Campuses across Florida
- 2,188 beds
- Largest provider of healthcare in Florida
- Largest by some measures in the entire United States
Nicholson Center

- Surgical Education
  - Robotic Surgery
  - Laparoscopic Techniques
  - Orthopedic Equipment

- Surgical Research
  - Robotic & Telesurgery
  - Surgical Education
  - Automatic Surgery
Errors Eliminate Profits

• Minor Complication
  – Revisit eliminates all profit from the original surgery

• Major Complication
  – Revisit costs 3X the profit from the original surgery
Creating Experts & Eliminating Errors

10,000 hours to become an expert - Gladwell

“There is no excuse for the surgeon to learn on the patient.” – William Mayo, 1927
Medical Education – Explosion of Information

- Medical procedures are becoming more numerous and more complex – medical knowledge has “hypertrophied” (Cooke, 2006)

- Training residents to a common level of knowledge and competence is already impossible (Satava, 2008)
“The Perfect Storm” (Murphy, 2007)

- **Risk** to patient health. (McDougall, 2007)
- **Ethics** of practicing on patients. (Satava, 2004; Murphy, 2007)
- **Cost** is a barrier to training. (Bridges, 1999)
- **Insurance** coverage of educational actions. (Satava, 2004)
- **Working hour** limits. (Satava, 2004)
- **Availability** of training opportunities. (Birden, 2007; Davis, 1999)
- **Access** to training. (Dunkin, 2007; Spitzer, 1997)
- **Complexity** of modern surgery. (McDougall, 2007)
- **Volume** of unique procedures. (Reznick & MacRae, 2006)
- **Proficiency-based** Medicine. (Murray, 2005)
- **Quality** of technology. (Murphy, 2007)
- **Expectations** around computer technologies. (Murphy, 2007)
- **Acceptance** of technology. (Ziv, 2003)
- **Learning from Mistakes**. (Ziv, 2005)
Intuitive Surgical’s da Vinci Robot

Video at: http://www.youtube.com/watch?v=0NZLpWrJGgk
Robotic and Telesurgery Research using Simulation

**Telesurgery**
- Comms Latency:
  - Modify surgical procedures
  - Safe Telesurgery at 500ms
  - Match to City-Pairs
- Automatic Surgery:
  - Record Surgery in Simulator
  - Execute with Unmanned Robot
  - Identify Control Variables

**Simulation**
- Surgical Rehearsal:
  - Dynamic Organ Model in Sim
  - Patient-specific Rehearsal
  - Improve Surgeon Performance
- Military-use Validation:
  - Simulator of Robotic Surgery
  - Retain Skills in Theater
  - Define Deployable Package

**Robotic Curriculum**
- Consensus Conferences:
  - Define Certification Criteria
  - Develop Curriculum
  - Develop Training Tasks
- Curriculum Validation:
  - Validate the Program
  - Identify Testing Measures
  - Set Passing Criteria
Telesurgery: Communication Latency

Comm Latency = 1 + 2

1. Robot Commands
   - Surgeon Audio

2. Stereo HD Video
   - Team Audio
Telesurgery: Simulated Latency

da Vinci Skills Simulator

Mimic dV-Trainer
Simulation: Surgical Rehearsal
Telesurgery: Automatic Surgery
Industry Perspective

• **Simulation as a Research Lab**
  – Simulated environments are a viable and affordable research environment within which to conduct experiments.

• **Simulation for Rehearsal**
  – Simulation is a tool for real-time preparation for surgery.

• **Simulation for Education**
  – Redesign GME surgical courses to include simulators along with classroom and laboratory components.