Medical Simulator Training Systems for: Maternal-Fetal Health Surgery

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Prevalence of Medical Errors

- In 1999, Institute of Medicine estimates medical errors may be responsible for 98,000 deaths a year in U.S. hospitals.
- In 2008, HealthGrades pulls actual Medicare records and confirms that medical errors contribute to as many as 80,000 deaths annually.
- The incidence of medical harm is estimated to be 40,000 per day.
- Medical errors add **$3 billiion/yr** to healthcare costs.
- If medical errors were a disease, it would be one of the top ten contributors to death in the U.S.

Medical Errors: A Leading Cause of Death

Cause of Death	Annual Fatalities
Heart Disease [1] (2006)	631,636
Medical Errors [2] (2008)	**79,445**
Diabetes [1] (2006)	72,449
Alzheimer's [1] (2006)	72,432
Highway Fatalities [3] (2007)	41,059
Homicide [1] (2006)	18,573
Occupational Fatalities [4] (2007)	5,488
Wars in Iraq/Afghanistan [5] (2010)	5,420
Commercial Airline Fatalities [6] (2007)	0

[1] www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_14.pdf, [2] http://www.healthgrades.com/press-releases/,

[3] www-fars.nhtsa.dot.gov/Main/index.aspx. [4] www.bls.gov/iif/oshcfoi1.htm#2007

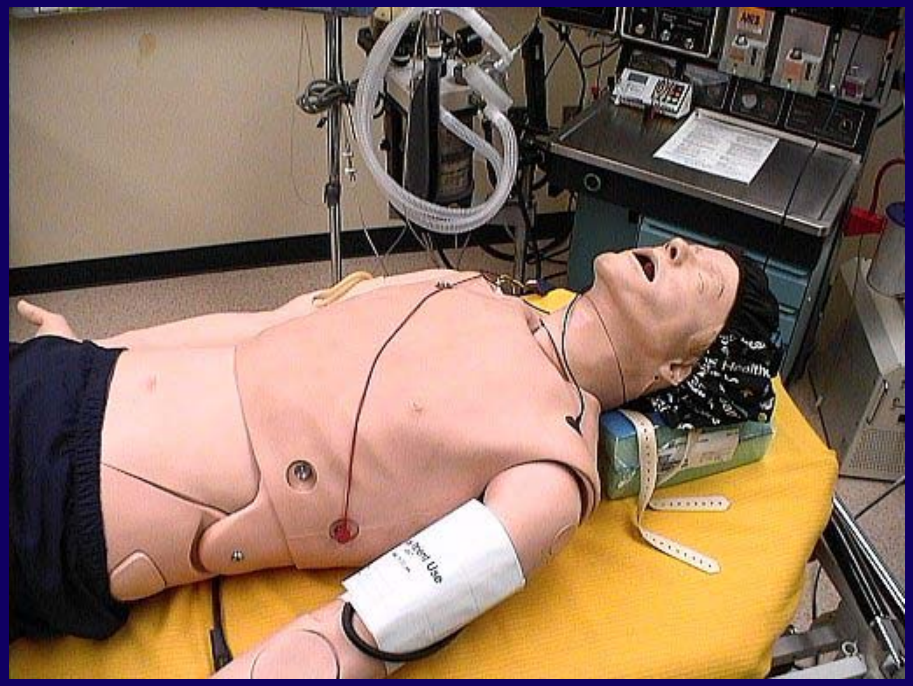
[5] www.defenselink.mil/news/casualty.pdf on Apr. 9, 2010, [6] www.ntsb.gov/Pressrel/2008/080416.html

Some Virginia Statistics

- In HealthGrades (2010), of 42 VA hospitals reviewed, *only 3* made it into the top 15% for patient safety, representing only 1.26% of all top performing hospitals in U.S.
- of the safety events studied, VA ranks among the poorest performers, in the bottom 10 states.
- Thomson Reuters 2010 Top 100 Hospitals in (only 1 in VA)
- VA ranks 9th in serious disciplinary actions taken by State Medical Licensing Boards (Public Citizen, 2010)

Current Medical Simulators Systems

Anesthesiology, Emergency Medicine, Nursing



SimMan (Laerdal, Inc.)

Current Medical Simulators Systems

Laparoscopic Surgery

LapSim
(Immersion Medical, Inc.)

LapTrainer
(Simulab, Inc.)

Commercial Simulators Across Medical Specialties

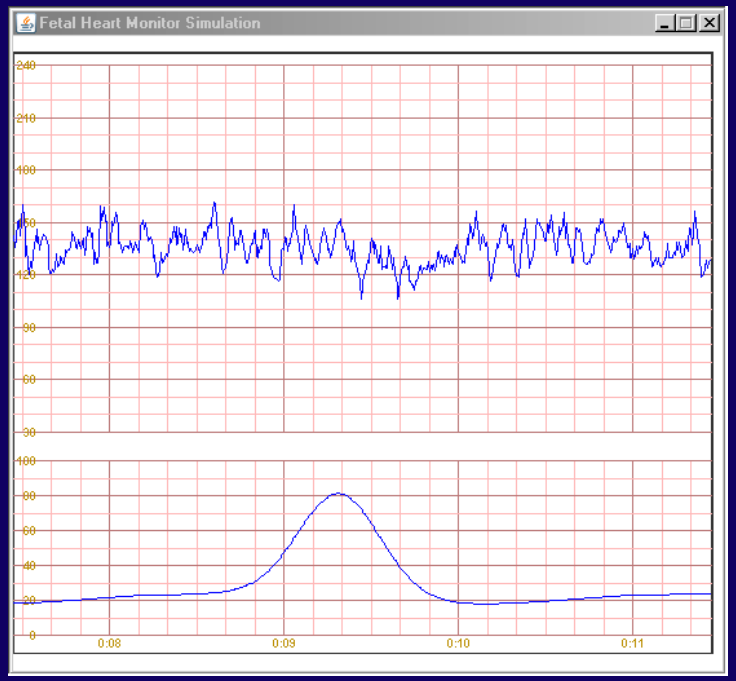
General surgery (laparoscopy) (8)
Emergency medicine (6)
Anesthesiology (4)
Radiology (3)
Obstetrics and gynecology (3)
Psychiatry/Psychology (2)
Orthopedic surgery (1)
Colon and rectal surgery (1)
Urology (1)

Cardiothoracic surgery
Physical medicine/Rehabilitation
Plastic surgery
Preventive medicine
Ophthalmology
Medical genetics
Neurology
Neurosurgery
Nuclear medicine
Otolaryngology
Pathology
Allergy and immunology
Dermatology

Simulation training systems that fill in gaps in medical curriculum

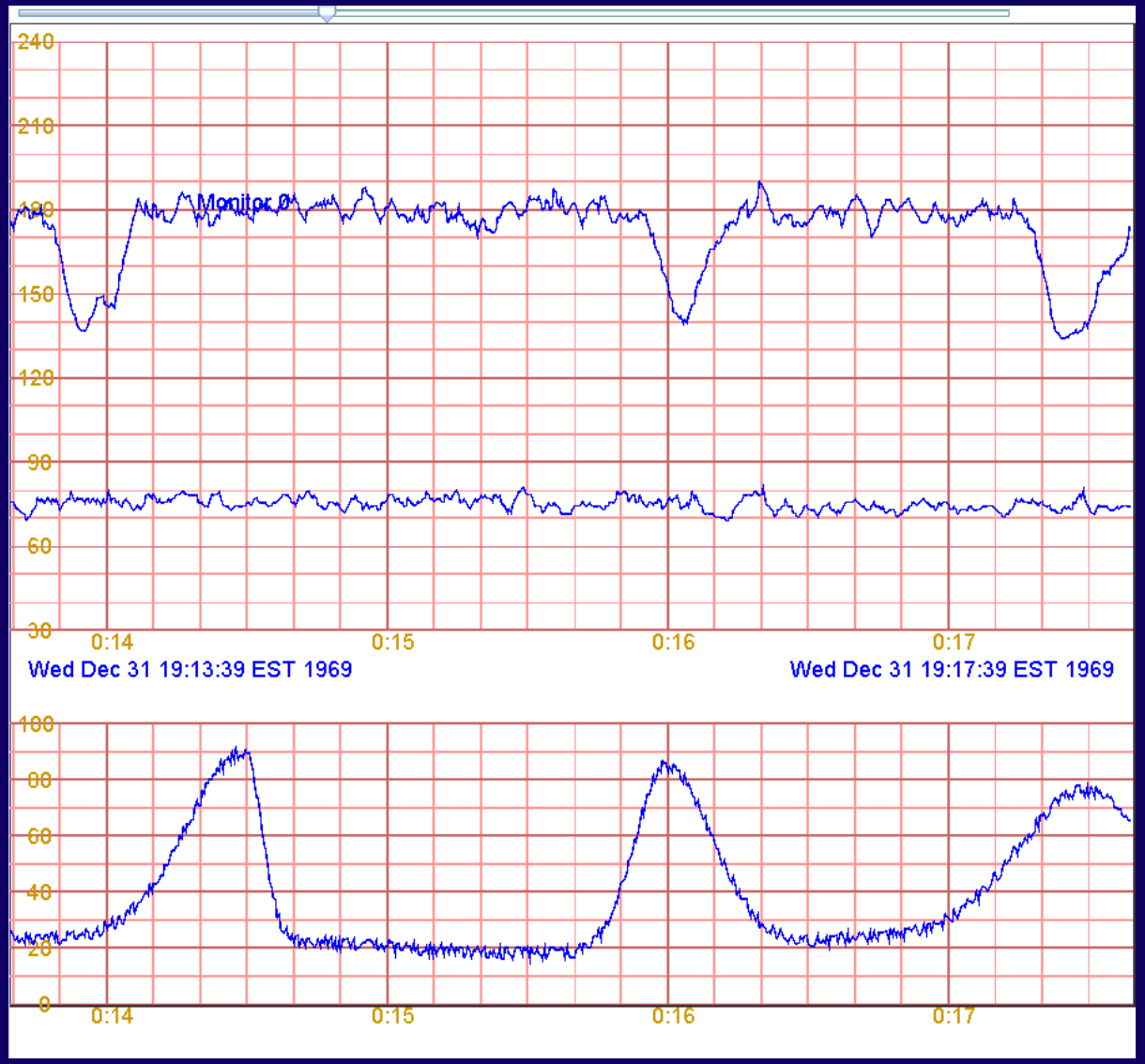
Maternal-Fetal Heart Rate Simulator

A training system for identifying potentially ominous signs in maternal-fetal heart rate tracings.



Technology Applications

- Accelerations, decelerations
  - Defined by a bell curve shape
  - Parameterization morphs curve into desired appearance
  - Analysis of actual tracings to determine typical profile and frequency
- Short-term variability can be changed
- Heart rate baseline can be changed at any time
- Authoring interface for building custom scenarios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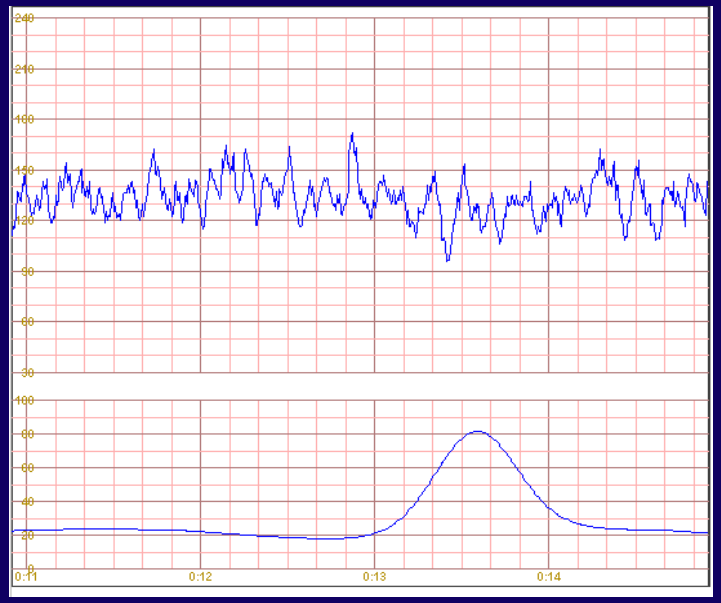
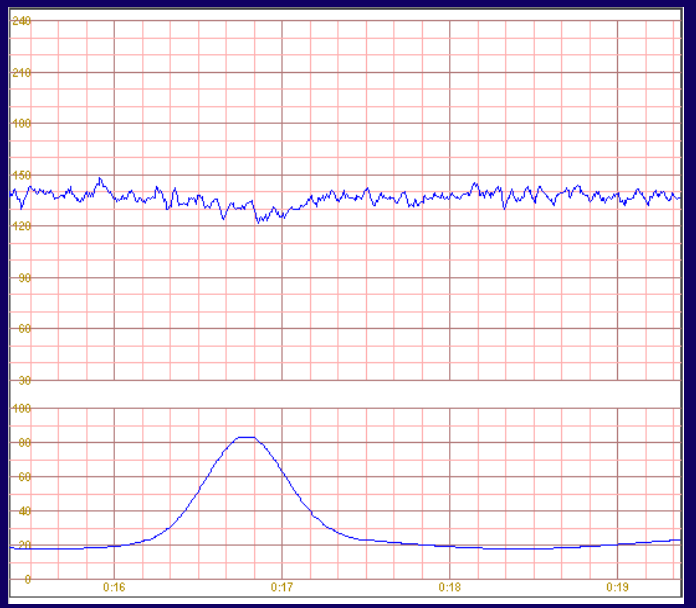
Technology Applications

- Play a custom scenario
- Play an actual patient record
  - Real time and accelerated
- Play four concurrent custom scenarios

Sample MFHR Images



0-sec Delay
Marked Variability, S/N = .35



4-sec Delay
Moderate Variability, S/N = 1.0

Commercial Applications

- Can be used to train and assess medical students, residents, nurses, and other Labor & Delivery personnel
- Can be used in educational settings or clinical environments

Collaboration Opportunities

- Old Dominion University and Eastern Virginia Medical School welcome opportunities for collaboration and licensing arrangements

Sources of Error in the OR

SOCIETAL and CULTURAL PRESSURES: politics, media scrutiny

LEGAL and REGULATORY RULES: legal liability, work practice constraints

ORGANIZATIONAL BEHAVIOR: safety culture, reporting practices, work scheduling, economics

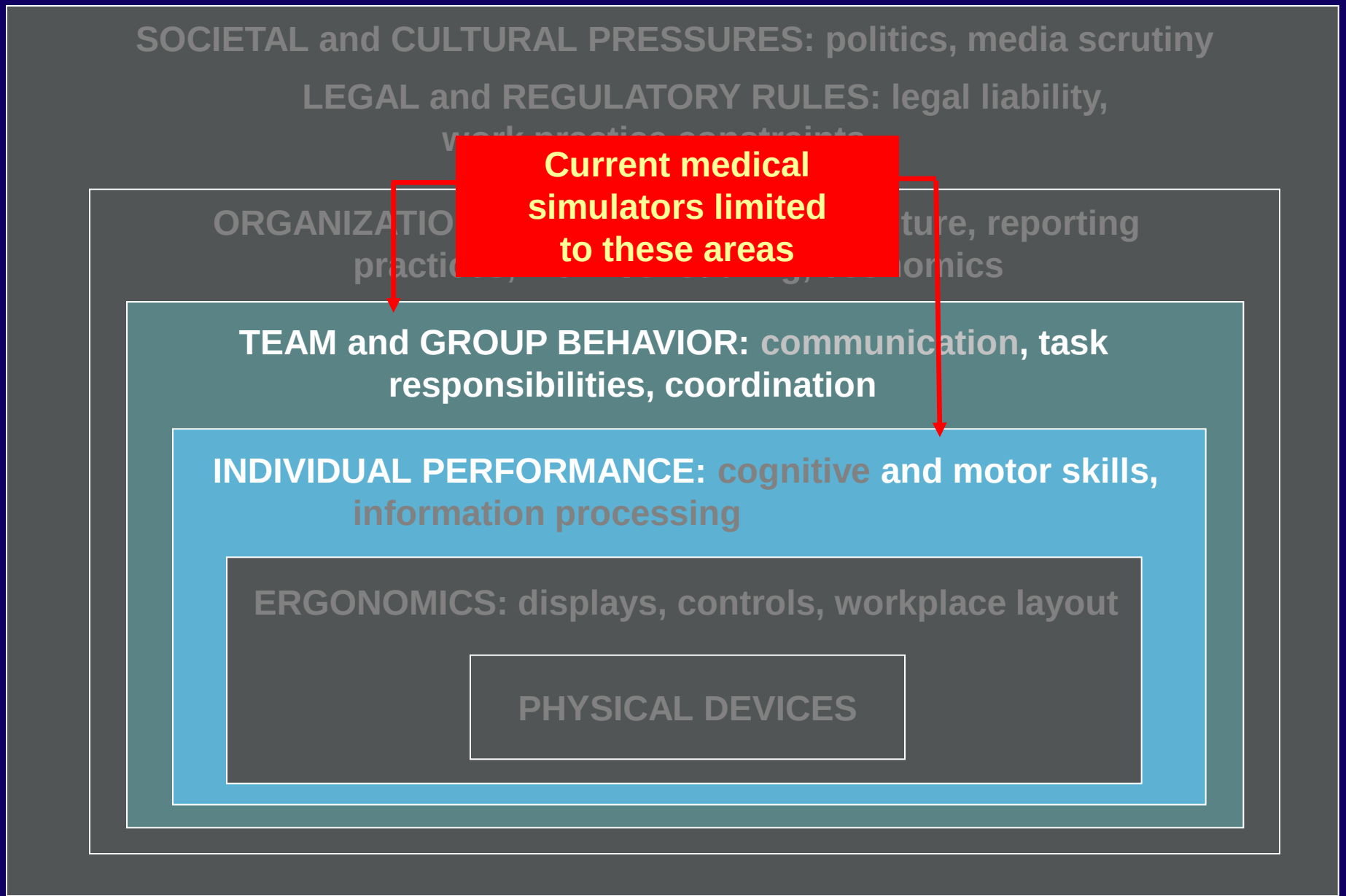
TEAM and GROUP BEHAVIOR: communication, task responsibilities, coordination

INDIVIDUAL PERFORMANCE: cognitive and motor skills, information processing

ERGONOMICS: displays, controls, workplace layout

PHYSICAL DEVICES

Sources of Error in the OR



The Virtual Operating Room

- A fully immersive virtual environment representing a standard OR
- Incorporates real and virtual team members, equipment, and medical simulators

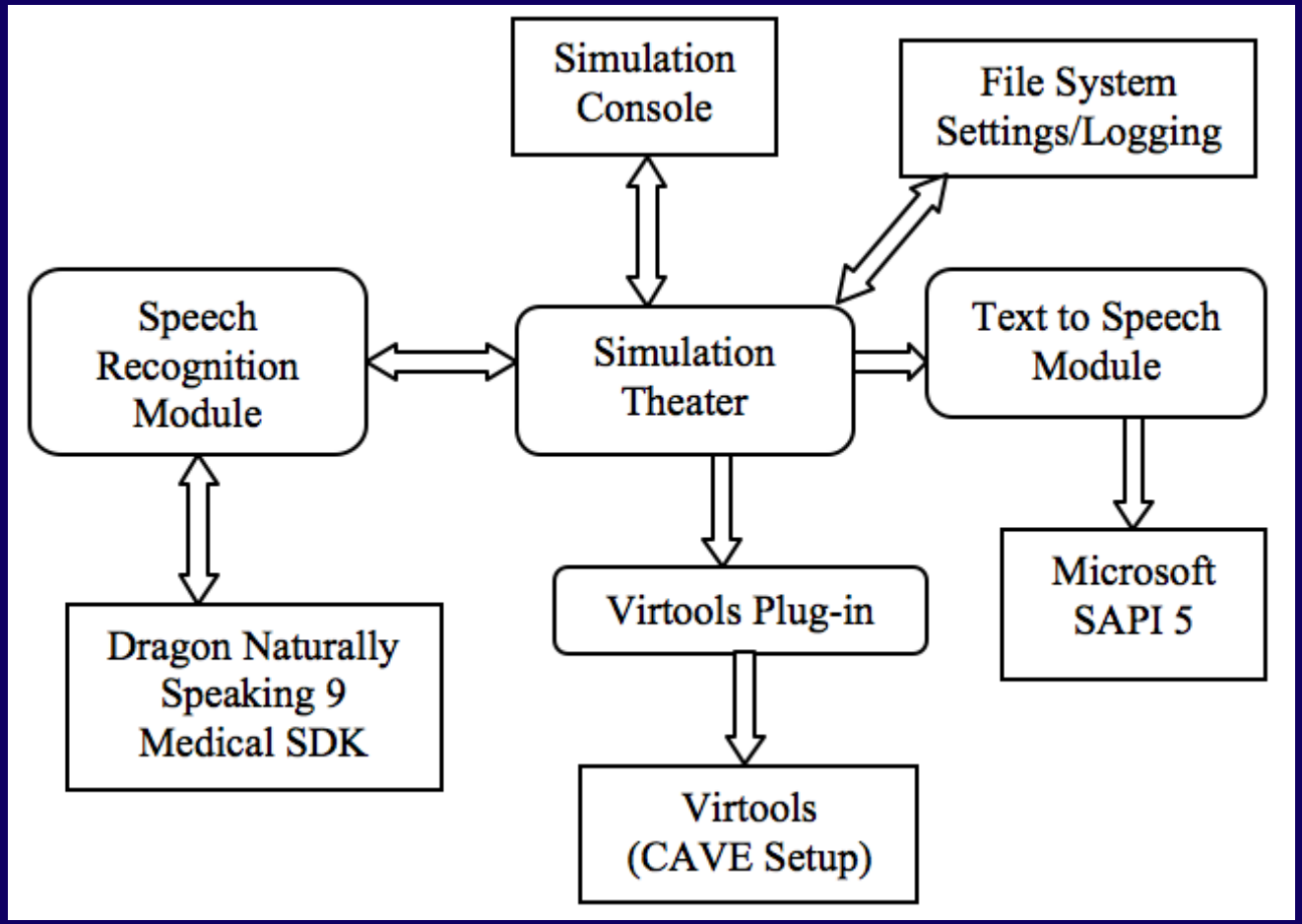
The Virtual Operating Room

- Surgical procedure - Laparoscopic cholecystectomy (gall bladder removal) performed on LapTrainer (Simulab, Inc.).
- OR environment modeled on a genuine OR

Computer-Based Agents

- Architecture supports computer-based agents that substitute for team members
- Scripted agents follow procedures approved by subject matter experts
  - Sequencing provided by hierarchical state machine
  - Voice recognition triggers transitions
  - State drives animations and specifies interactions with other agents

Simulation Infrastructure



Commercial Applications
The Virtual Operating Room

- Exercises the problem-solving, decision-making, and team skills of trainees in a contextually appropriate environment
- Can be used to train surgical teams, individually or in units
- Provides training across specialties: surgeons, nurses, technicians
- Can be used to address all sources of error in the OR without putting patients at risk

Commercial Applications The Virtual Operating Room

- Provides tighter control over the training environment and manipulation
- Provides greater consistency in training experiences because the environment and scenarios are computer-based
- Can be deployed in a fully immersive or smaller scale environments

Collaboration Opportunities

- Old Dominion University and Eastern Virginia Medical School welcome opportunities for collaboration in
  - Physiological modeling
  - Serious gaming
  - Speech recognition and natural language interfaces
  - Artificial intelligence and intent inferencing

Contact Information

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