Recent Advances in Virtual Worlds for Science and Technology Research and Development

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Overview

- Recent virtual world projects for Science or Technology R&D
- Future opportunities for virtual worlds for science and technology R&D

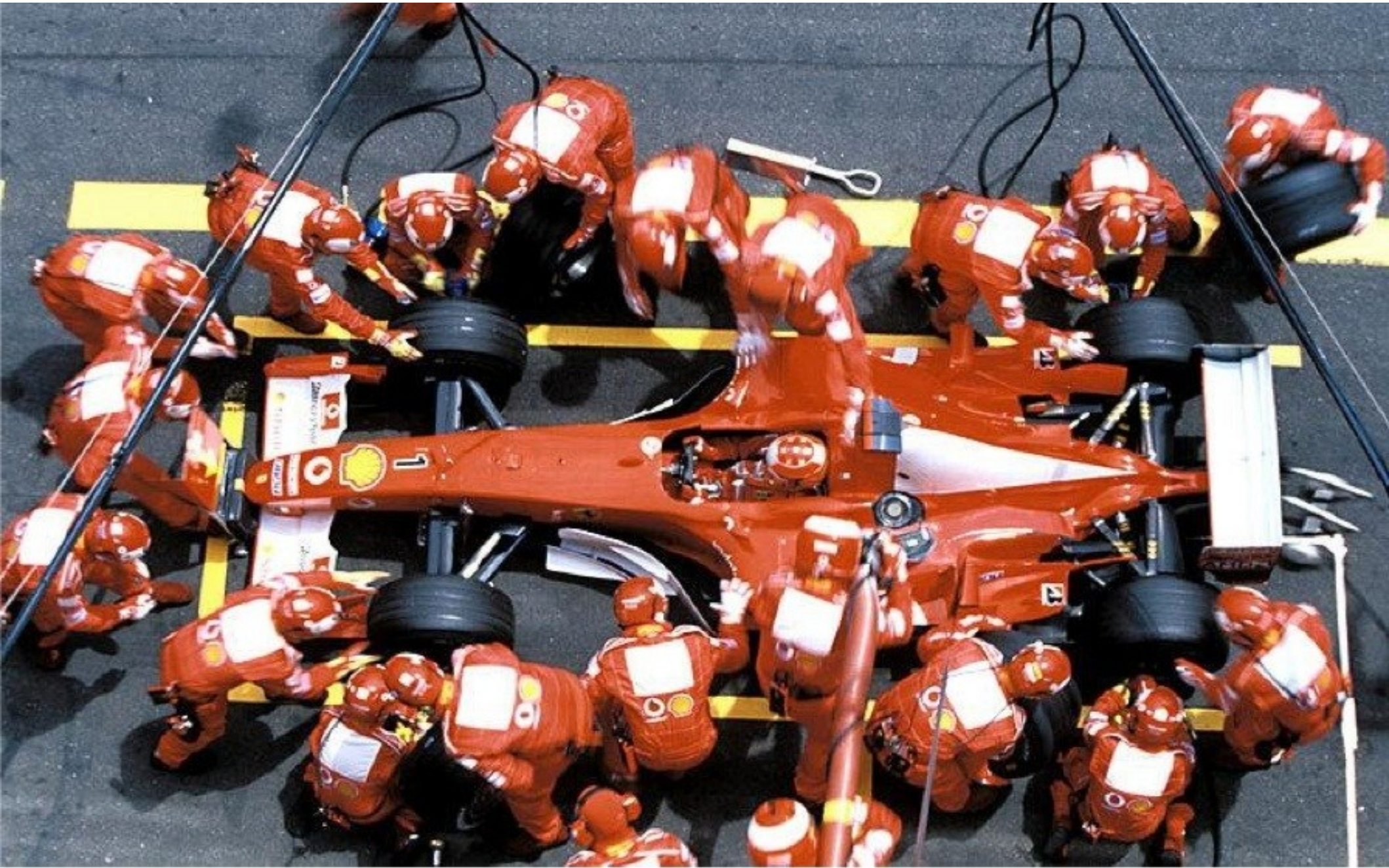
Strategies for Creating Value with Virtual Worlds

- Creating game-based learning environments with virtual worlds
  - "Play" and experiential behavior are surprisingly effective way to audition, rehearse, act, fail, and learn
  - Mixed reality worlds can link virtual and physical activities
  - Virtual worlds are best at providing new *experiences*
    - Virtual work practices
    - Not the same as existing work practices
    - Need to learn what to do, how to do it, and more
      - Not obvious how to be faster, better, and cheaper using virtual worlds!

Collaborative meeting work in virtual world

Collaborative work in physical world

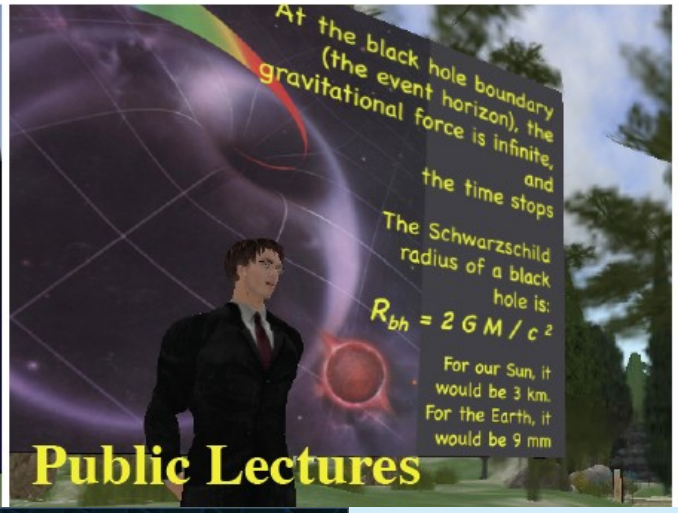
Radically colocated work in physical world

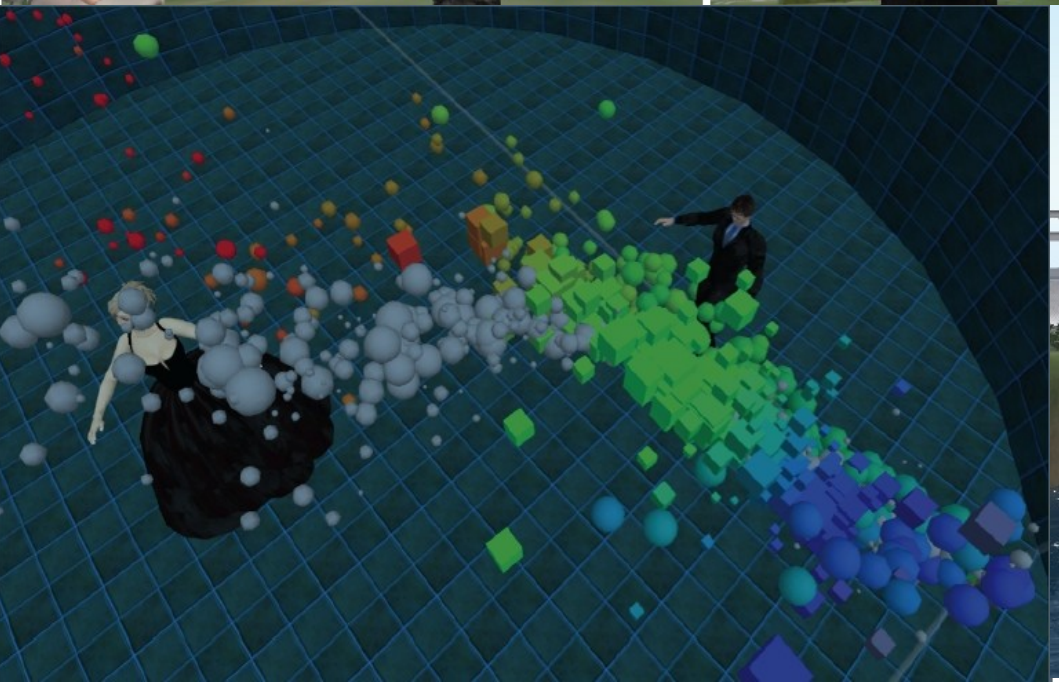


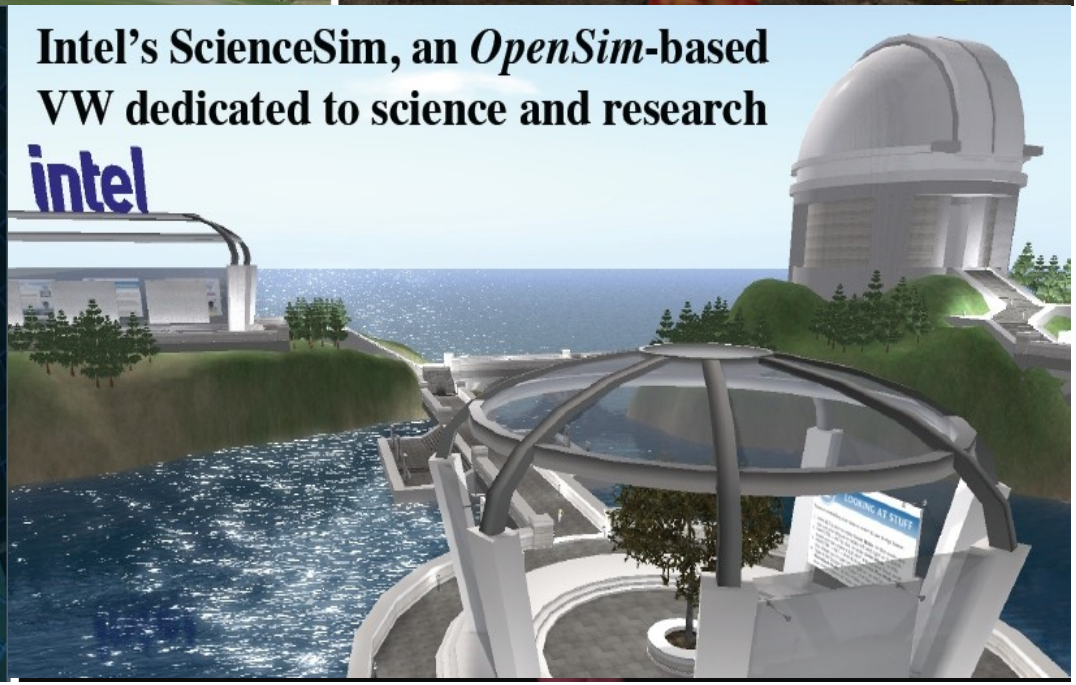
Recent Virtual World Projects for Science and Technology R&D

- Collaborative science meetings and immersive simulations
  - Meta Institute for Computational Astrophysics
- Collaborative science learning and data exploration environment with spherical displays at *Discovery Science Center* and in *OpenSim*
  - Science on a Sphere
- Collaborative game world for semiconductor fabrication or nanotechnology design
  - FabLab training simulator
- Game-based virtual worlds for advanced health care
  - Robotic therapeutics and tele-rehabilitation
- Envisioning future virtual worlds for possible cultural experiences and new technological innovation opportunities
  - Virtual Life 2010+
  - Immersive motorsports racing experiences
    - Low-cost to high-cost virtual world simulators
  - OutRun @ UCI

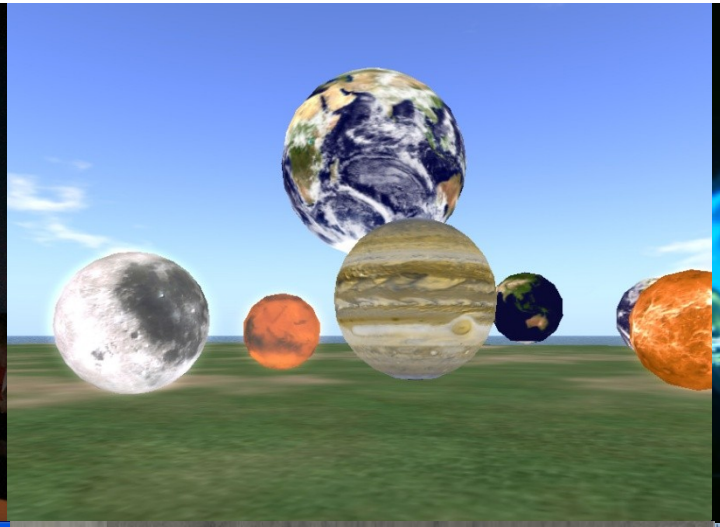
Virtual Worlds for Scientific Collaboration:
Meta Institute for Computational Astrophysics

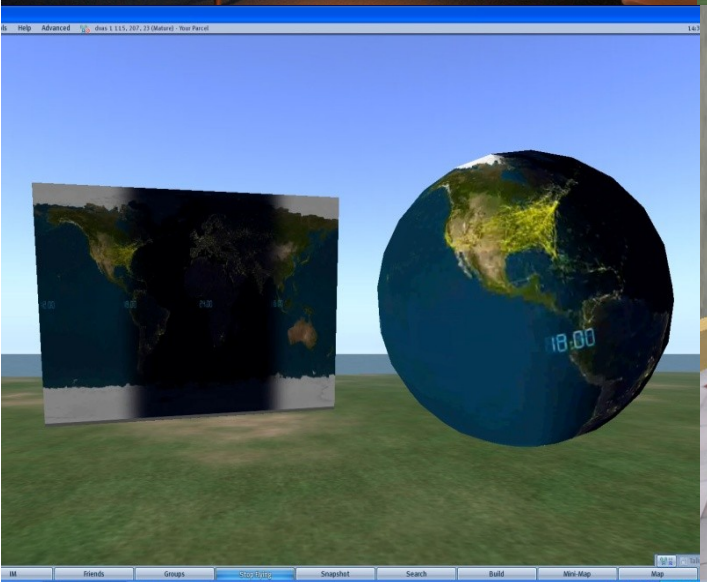


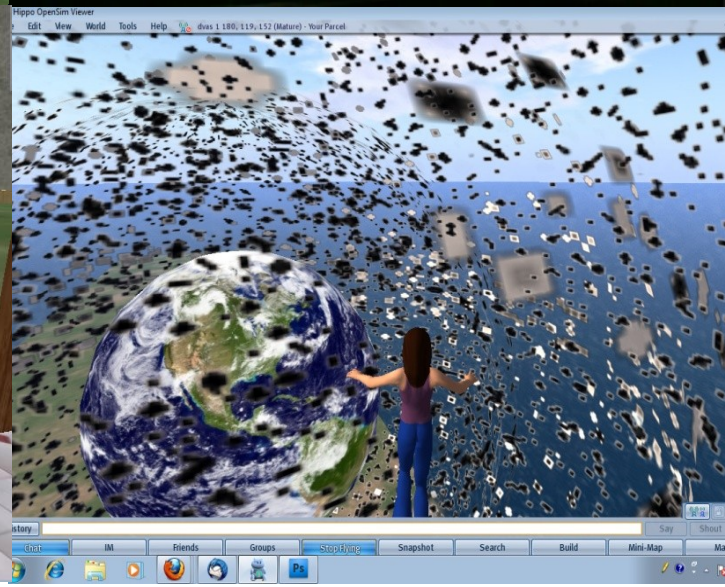




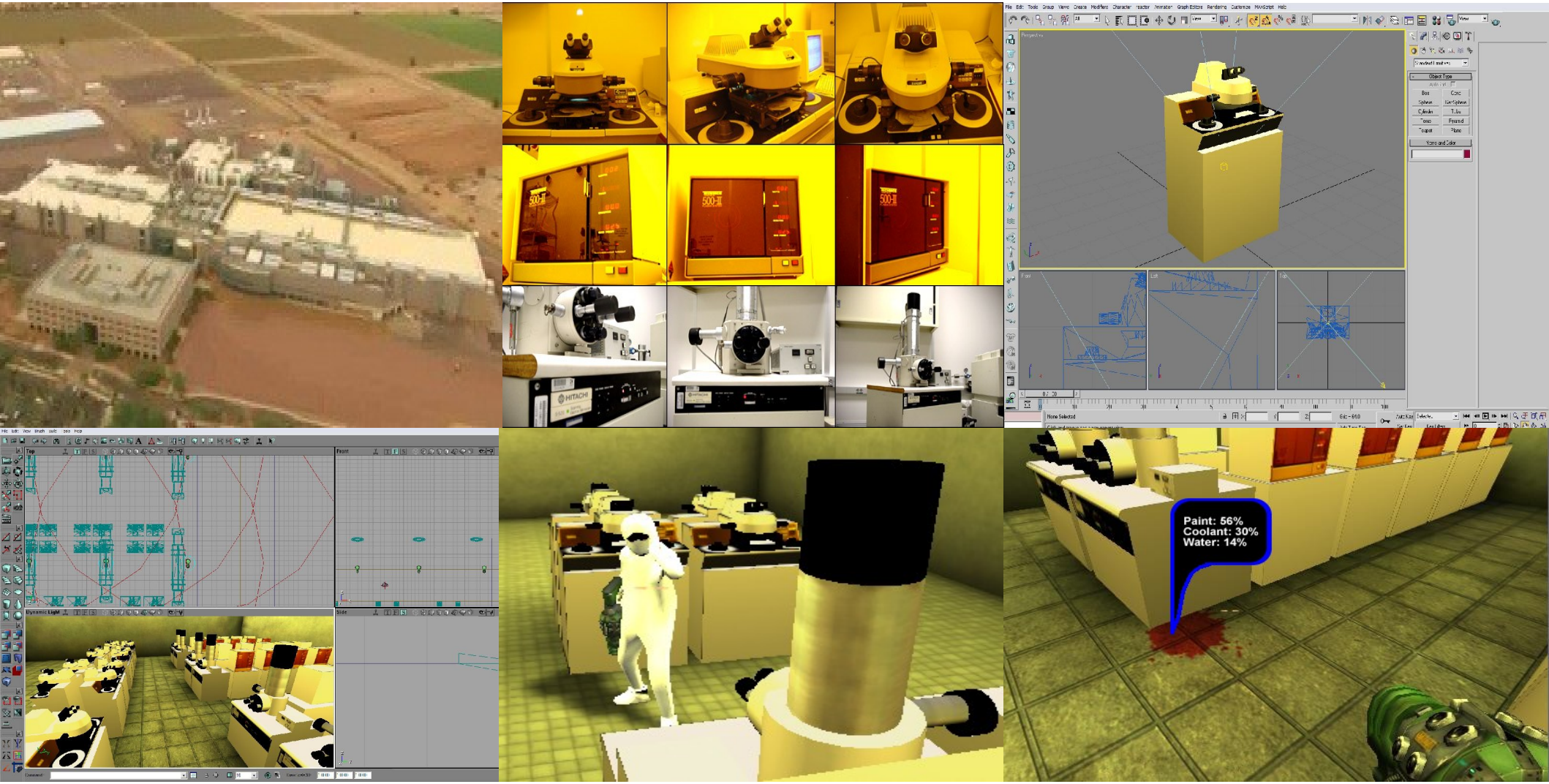
Spherical displays and “spherecasting” support: *NOAA Science on a Sphere* installation in *Opensim*





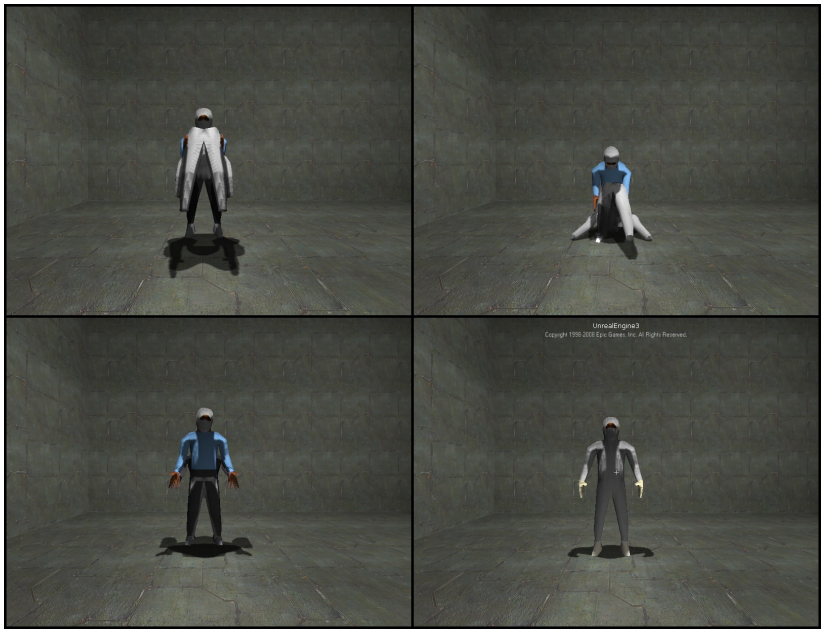


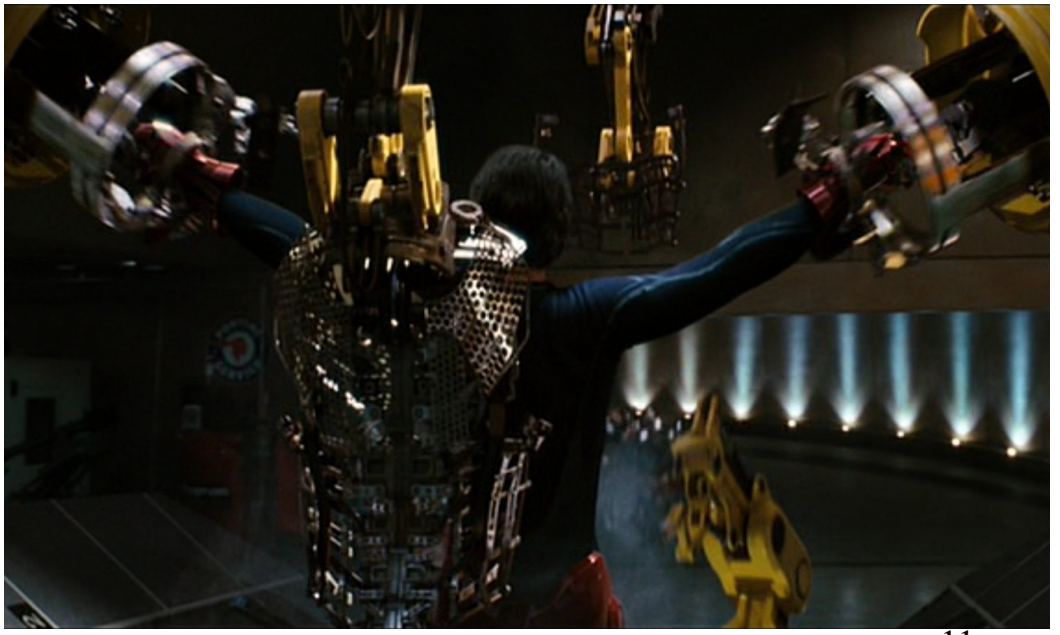
Game-based virtual world for semiconductor/nanotech fabrication training, remote presence and diagnosis



FabLab Demo Reel

Semiconductor/nanotechology fabrication training game





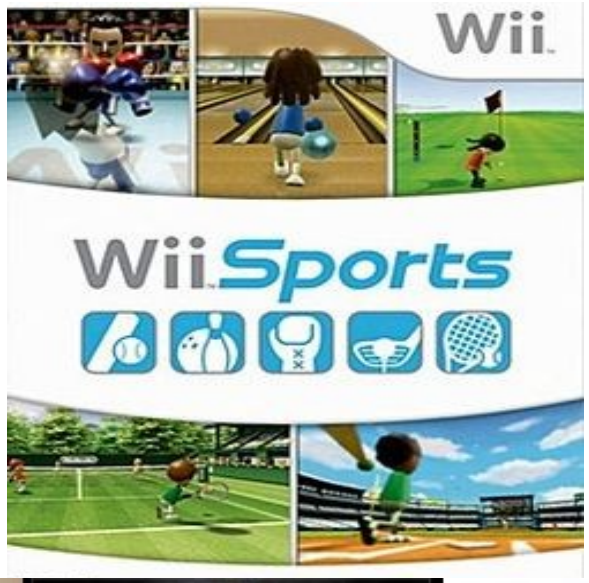
Virtual worlds for health care and tele-rehabilitation

- **Virtual worlds can be used to support various kinds of tele-medicine and tele-robotics applications/tasks**

- **"Rehabilitation" tasks supported can include:**
  - **Remote observation, tele-consultation, role-playing and identity switching through avatars, device data collection, device software updates, collaborative product/prototype development, and more**

Assisted performance training and robotic rehabilitation

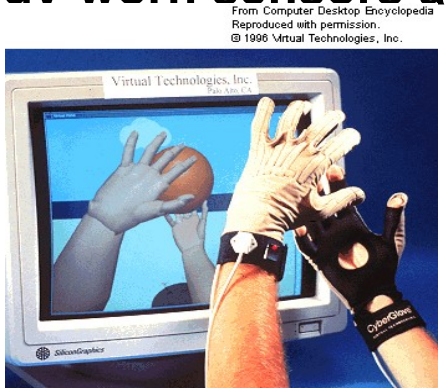
- ***Wii Sports*** **(best selling game for Nintendo in 2007; 45M copies sold worldwide through 2009)**
  - **Boxing**
  - **Bowling**
  - **Golf**
  - **Tennis**
  - **Baseball**



What's next?

VW haptic interfaces with therapeutic applications

- **Simulated devices**
  - ***Guitar Hero* guitar; *Rock Band* drum set**
- **Haptic wheels, trackballs, and joysticks**
- **Force-feedback play controllers (racing game wheels, pneumatic bladders)**
- **Multi-sensor play controllers (including video capture, infra-red, accelerometers, neurological sensors, electro-goniometers (SEMG), etc.)**
  - **Wii Remote and nunchuk**
- **Multi-jointed, bodv-worn sensors as play controllers**
  - **Data gloves**



  - **GypsyMIDI**

Haptic interfaces with possible therapeutic applications

- **Endoscopic surgery training "joysticks"**
  - **Simball 4D joystick adapted to therapeutic game play for stroke rehabilitation**
  - http://www.g-coder.com/content/view/7/6/

- **3D, real-time video motion capture enabling *mixed reality game play* spanning physical and virtual worlds**
  - ***Project Natal* at Microsoft**
  - **In-game characters can interact with human players through gestures and body movements**
  - http://www.youtube.com/watch?v=g_txF7iETX0

Some findings on Games for Health/Therapeutic Applications

- **The design and utility of a game to realize therapeutic value is <u>not</u> obvious.**

E. Flores, G. Tobon, et al., Improving Patient Motivation in Game Development for Motor Deficit Rehabilitation, *ACM 2008 Intern. Conf. Advances in Computer Entertainment,* 381-384.

Table 1. Gaming design criteria for stroke rehabilitation programs serving elderly users

Criteria for Stroke Rehabilitation	Criteria for Elderly Entertainment
• Adaptability to motor skill level • Meaningful tasks • Appropriate feedback • Therapy-Appropriate ROM • Focus diverted from exercise	• Appropriate cognitive challenge • Simple objective/interface • Motivational Feedback • Element of social activity • Appropriateness of genre • Creation of new learning following guidelines of experts • Sensitivity to decreased sensory acuity and slower responses

CRITERIA		Pong	Driver's SEAT	Whack-a-mouse	Tetris	Computer Chess	Trivial Pursuit
Stroke Rehab	Adaptability to motor skill level	✓	✓	✓			
	Meaningful tasks	✓	✓				
	Appropriate feedback		✓	✓			
	Therapy-appropriate ROM			✓			
	Focus diverted from exercise	✓	✓	✓	✓	✓	✓
Elderly Entertainment	Appropriate cognitive challenge				✓	✓	✓
	Simple objective/interface	✓	✓	✓	✓	✓	✓
	Motivational Feedback	✓	✓	✓	✓	✓	✓
	Element of social activity	✓				✓	✓
	Appropriateness of genre	✓	✓		✓	✓	✓
	Creation of new learning					✓	✓
	Sensitivity to decreased sensory acuity	✓	✓	✓	✓	✓	✓
	Sensitivity to slower responses	✓	✓	✓	✓	✓	✓

Envisioning collaborative virtual worlds 2010-2012

Virtual Life Demo Reel

Game-Based Virtual World Simulator Interfaces for immersive motorsports racing experiences

Game-based virtual world simulator you can actually drive in physical world! -- *OutRun* @ UCI

Future opportunities for games and virtual worlds

- Key challenges to address/overcome -- *scale* and *scope of:*
  - *Immersion*
  - *Verisimilitude*
    - *Within worlds*
    - *Spanning physical-virtual worlds*
  - *Co-participation and Collaborative work*
  - *Relocatability (telepresence)*
  - *Decentralized virtual organization*
- *New research center for Computer Games and Virtual Worlds at UCI*
  - http://cgvw.ics.uci.edu
  - *Funding from National Science Foundation #0808783, Digital Industry Promotion Agency (Daegu, South Korea), and others.*
  - *Want to come and play with us?*