

RERC RecTech • State of the Science

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*Simulation of Human Motion in
Immersive Virtual Environments*

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Acknowledgments

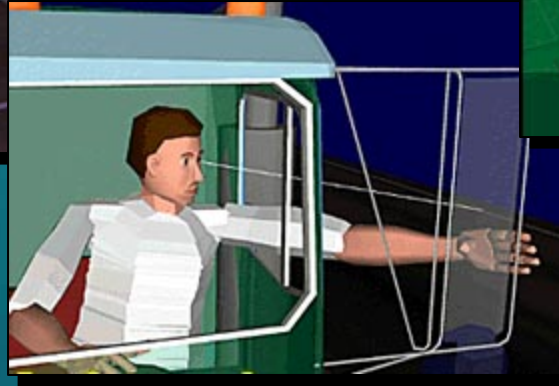
- Prof. Pat Banerjee
- Prof. Michael Scott
- Silvio Rizzi
- Shun Liang

Contents

- Introduction
- Rehabilitation of patients using virtual environments and tele-rehabilitation
- Tracking human motion for avatar animation
- Efficient human motion simulation using inverse kinematics
- Video demo showing real-time performance
- Conclusions

Introduction

- Avatars are 3D representations of human beings (a.k.a. virtual humans)
- Avatars mimic participant's movements and actions in virtual environments
- Useful for analysis of human motion and posture
- Example: Jack (University of Pennsylvania)



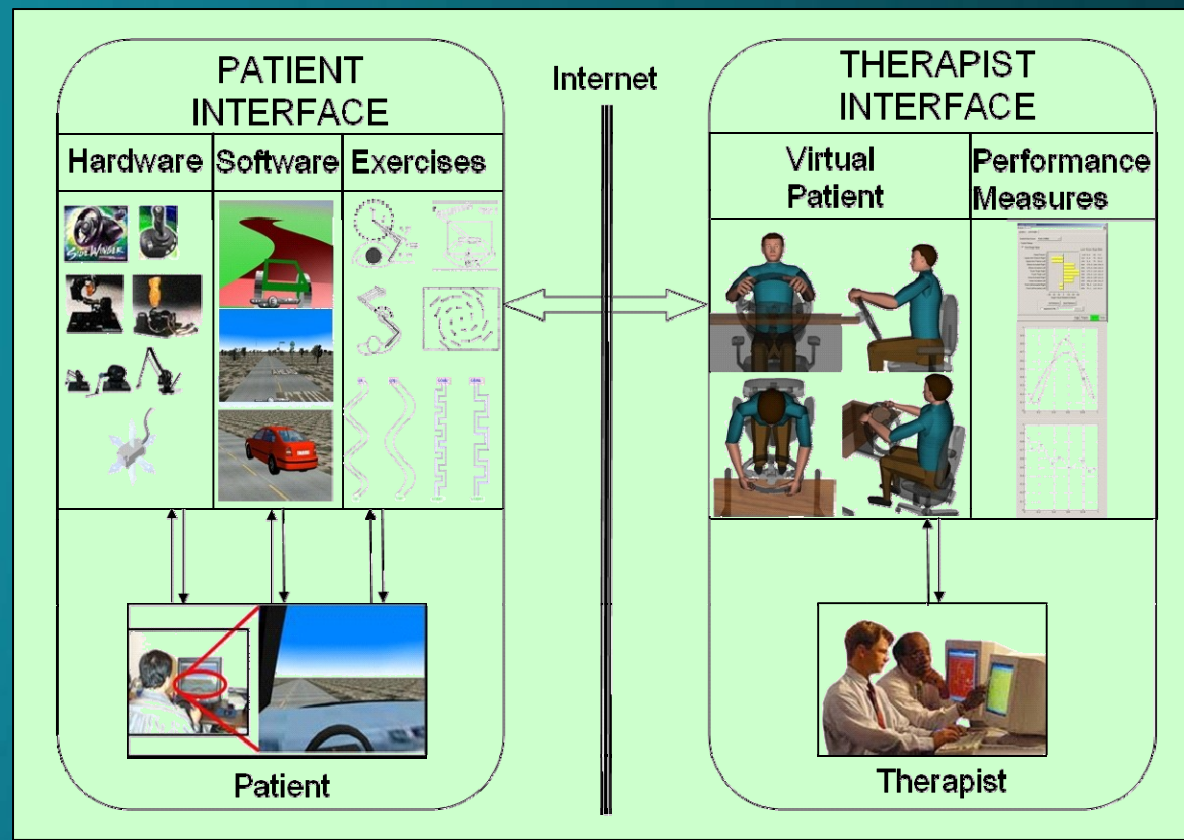
Recovery of patients with strokes in immersive virtual environments

- Clarkson University
- Movement of avatar arm by moving own arm
- Wearing electromagnetic sensors to measure arm position/orientation & electromyography sensors to measure muscle activity
- Patient working to recover range of motion in her arm or grip



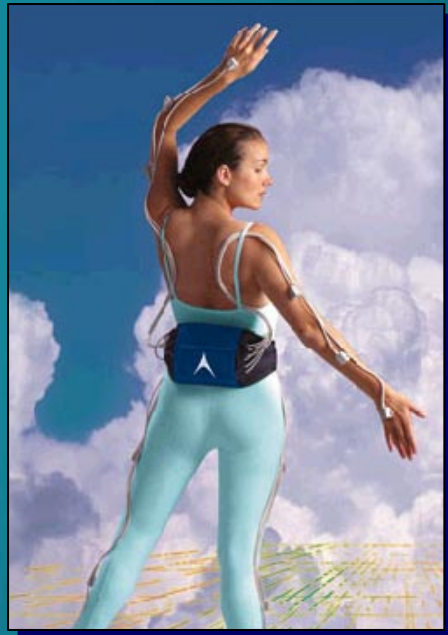
Tele-rehabilitation

- SUNY Buffalo
- Virtual driving simulator with haptic feedback for rehabilitation of lost motor coordination skills in stroke patients



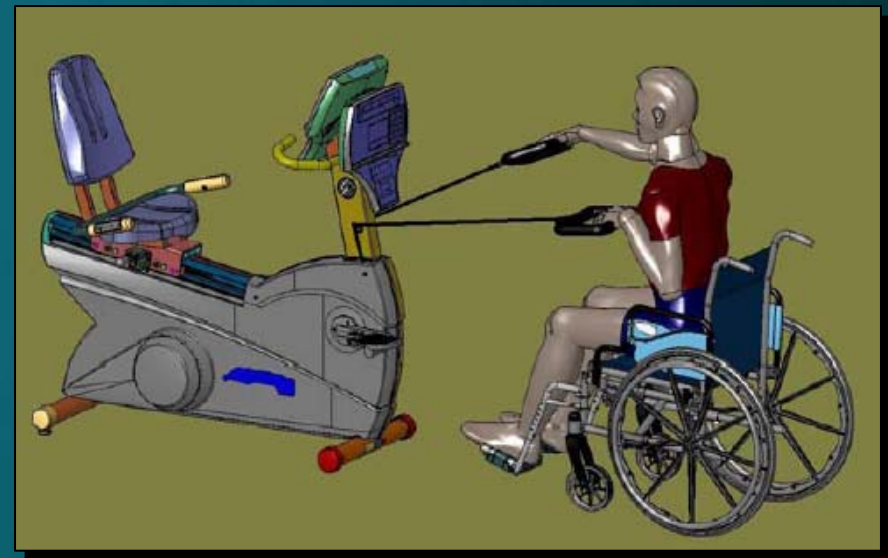
Simulation of human motion using multiple sensors

- Multiple sensors attached to body to track positions and orientations of all limbs
- Very accurate simulation
- But cumbersome to use with people with disabilities



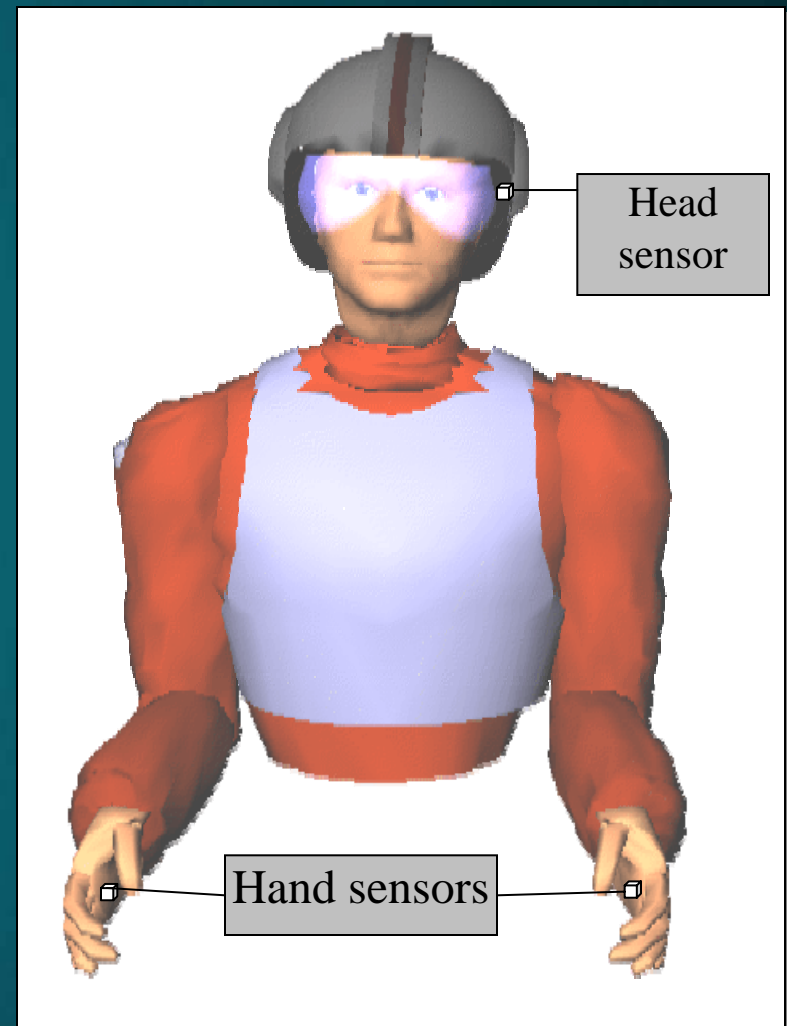
Exercise equipments for upper-body rehabilitation

- University of Illinois at Chicago:
 - Industrial Virtual Reality Institute
 - Engineering Design and Decision Laboratory



Simulation of upper body using only 3 sensors

- Only 3 sensors are attached to body: head and both hands
- Objective:
 - Compute the positions and orientations of torso, arms and forearms (inverse kinematics)
- Goals:
 - Produce natural good-looking postures
 - Achieve high real-time performance



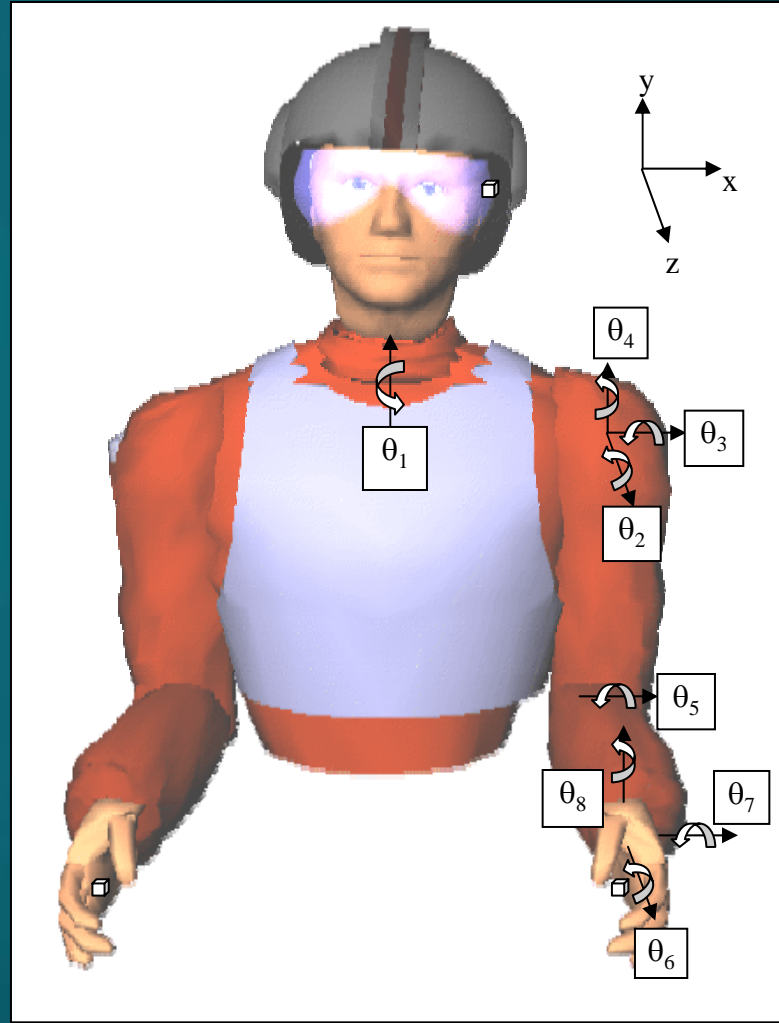
Upper body as an 18-DOF kinematical structure

Rotational torso

Spherical shoulder

Rotational elbow

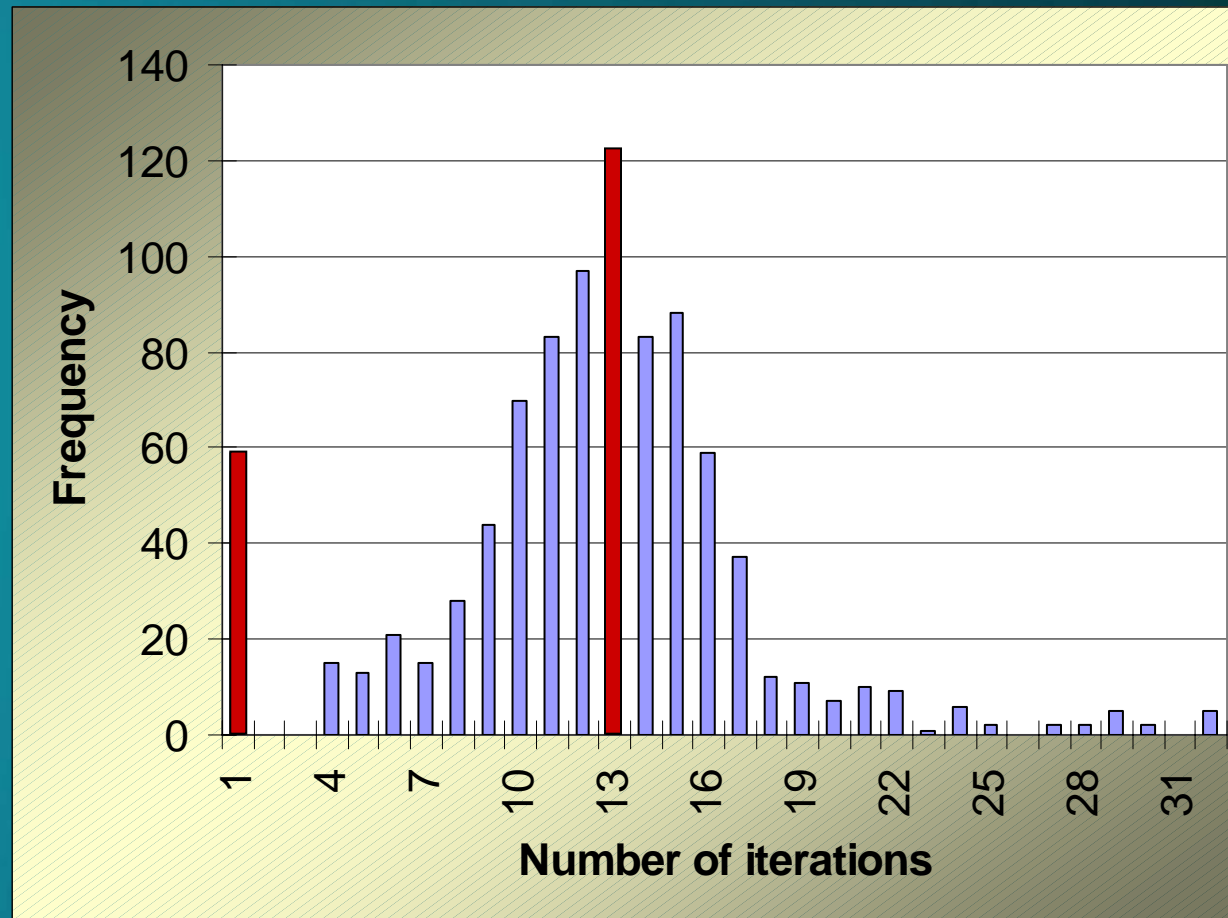
Spherical wrist



Avatar mimicking patient in a virtual reality environment



Real time performance



Conclusions

- Only 3 sensors are sufficient for human upper-body animation
- Avatars represent great potential in rehabilitation using virtual environments
- Implemented inverse kinematics algorithm produces realistic and natural postures
- Efficient real-time performance

Thanks!

- Any questions or comments?

