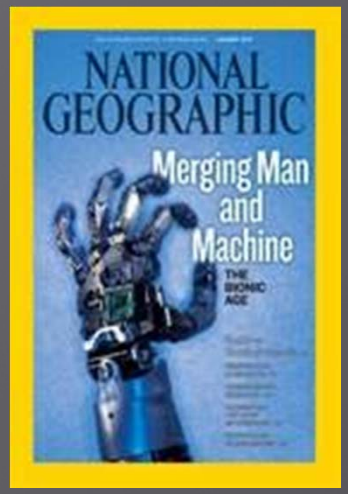
REHABILITATION ROBOTICS



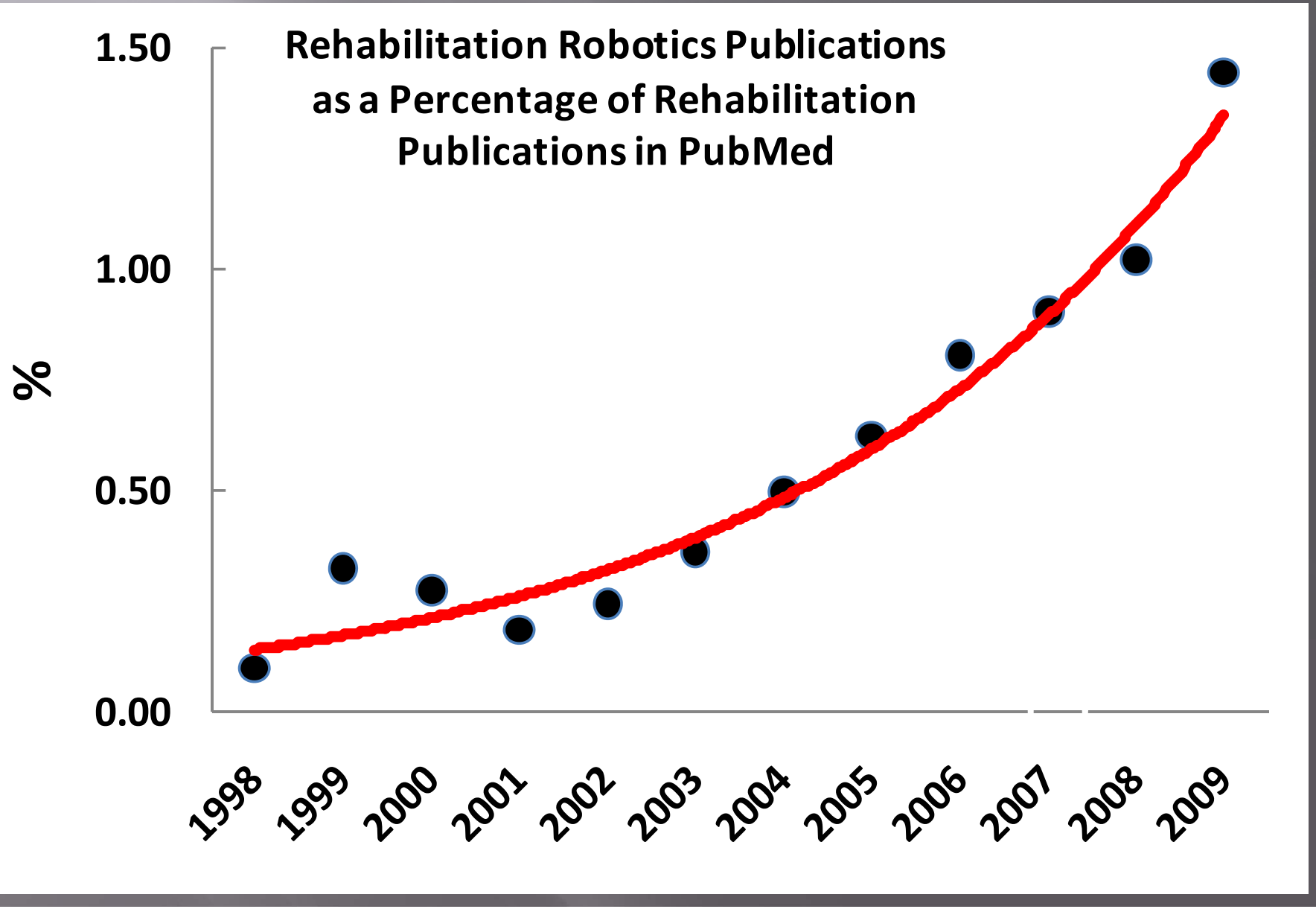
Team Science
Designing the Future

Edward A. Hurvitz, M.D.

What is a Robot?

A device that automatically performs complicated often repetitive tasks; a mechanism guided by automatic controls

Rehabilitation Robotics



Types of Robots

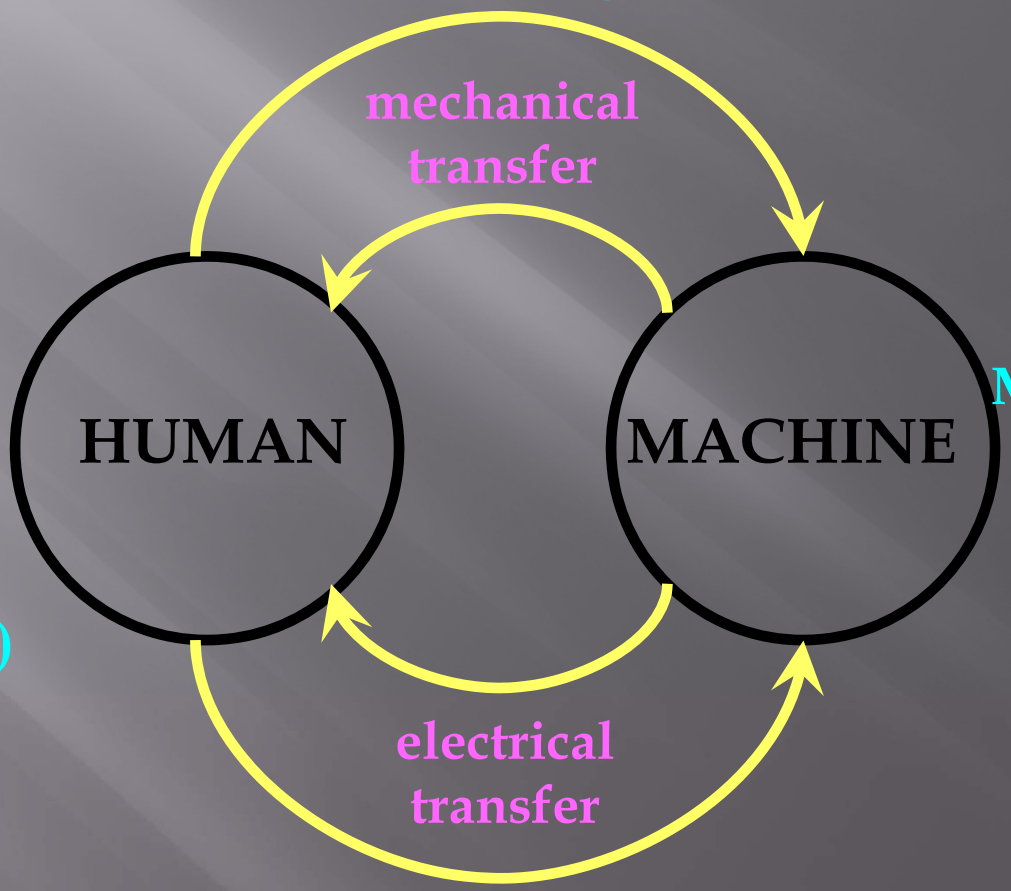
- Prosthetic Limbs

- Powered Orthotics
- Therapy Assist Devices

- Mobility Units
- Environmental Control/Manipulation Units

- Brain Computer Interface

Rehabilitation Robotics Cluster Hire



How does that work?

- Clinician helps define clinical need for better orthotic
- Mechatronics designs the components for a new orthotic that works with feedback
- Bioengineer develops ways to improve feedback mechanisms to provide data to orthotic
- Kinesiologist gives input on design based on biomechanical principles, and tests biomechanic output
- Clinician evaluates changes in function with new device

...and everyone give input at every phase of the project

Lokomat Training for Ambulation

- Weight supported Treadmill
- Single therapist
- Variation of program based on child's own abilities
- Varies weightbearing

Lokomat Results

- Improved Gait speed
- Increased endurance
- Higher scores on GMFM D and E
- Correlated with amount of training
- Some maintenance over time
- Some adverse effects
  - Muscle soreness, skin abrasion in up to 30%
- Greater effect for GMFCS I-II

Improved Kinematics (Patritti et al)

- Decreased double support phase
- Improved stride length
- Decreased ankle dorsiflexion in stance (decreased crouch)

Spasticity

- Lokomat measures muscle stiffness
  - Calculates torque at different movement speeds
- Tone reduction noted after single training session
  - Not measured over time

Upper Extremity Robotic Therapy

- Emphasizes repetition
- Children enjoy sessions, highly motivated
- Targeted movements with robotic assisst
- Provides visual feedback
- Offers games during breaks

CP study

- 12 subjects
- Improved QUEST
  - Dissoc. Movements
  - Wt Bearing
  - Total
- Fugl-Meyer score improved
- MAS went down
- Postive results 1 month r/u

Robotics vs. CIT

- Benefits patients with lower MACS level, ROM
- Less therapist intensive
- For both, less involved patients have better outcome
- Current protocol seemed best combined with outside RX

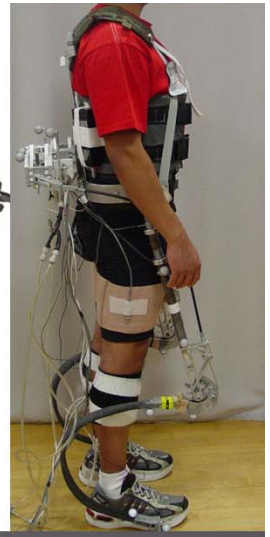
Cyberdyne

MIT

Argo Medical Technologies

Tibion

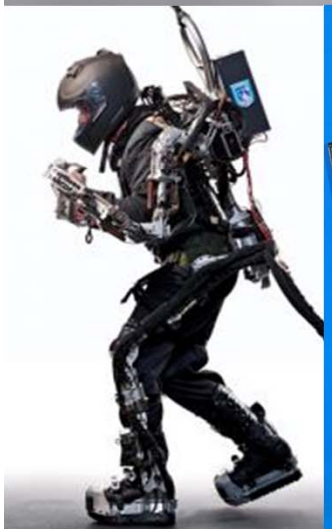
Berkeley Bionics



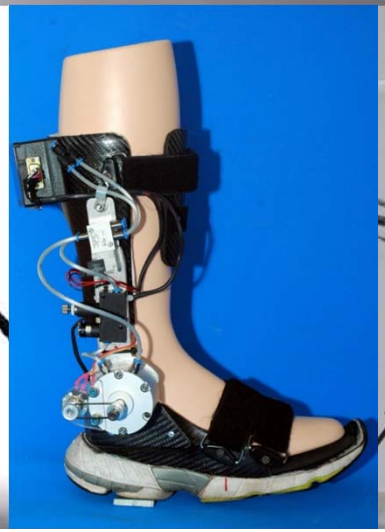
U Michigan

The Exoskeletons Are Here

Raytheon



U Illinois



Laval U

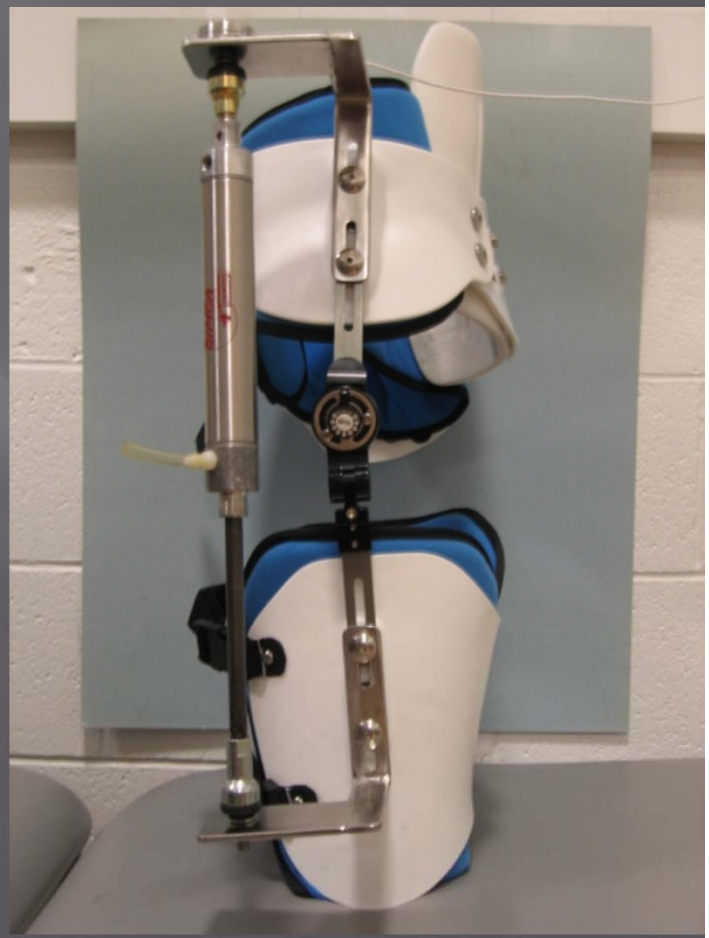
Honda

Honda

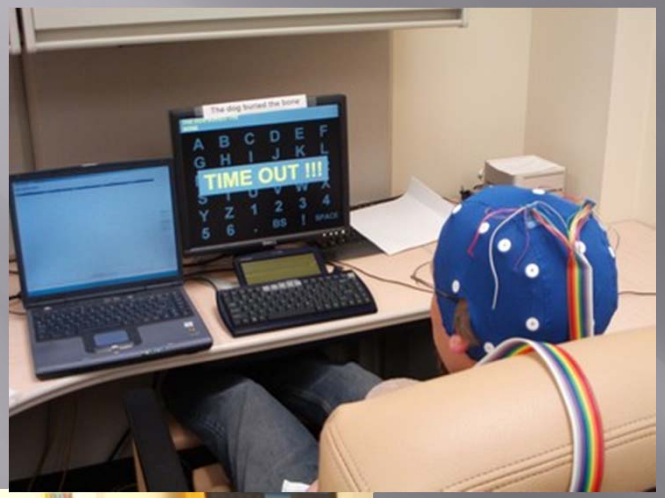
The Robotic Orthosis Lokomat

Institute of Automatic Control ETHZ
+ University Clinic Balgrist
+ Hocoma GmbH

Powered Orthoses



Direct Brain Interface



- EEG signals control system
- Works computer
- Can control W/C, ECU
- Currently slow, trying to improve scanning and speed

Robotic Power Mobility

- Crash avoidance
- Route Planning/Path Guidance
- Direct Brain Interface

Feeding robot

- Consistent presentation of food
- Feeding did not go as well as with hand feeding.

Robots
What we need to know

- What can they do?
  - As well as we do now
    - Consistency
    - Dependability
    - Cost Effective
  - Better than we do now
    - Adding to quality of life
    - Improving therapy effectiveness
    - Making rehabilitation more available