

# Design Challenges in Assistive Technology

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Perspectives in Assistive Technology

# Outline...

- Design Process
- Project Examples:
  - Handbike/Sunburst – arm-powered bikes
  - Inter-Limb Resistance – space exercise
  - Kine-Assist – robot assist for physical therapy
- Perspective



# Design Process

- Need (create one if necessary; be passionate)
- State-of-the-Art (it may already exist)
- Conceptual Design (this is the fun phase)
- Select Preferred Concept (tools/intuition)
- Detail Design/Analysis (don't give up!)
- Working Prototypes (make it work, sleep deprivation)
- Testing (does it really work?)
- Final Device (deliver something)
- Documentation (you'll build on it; share the credit)
- Technology Transfer (get it out there!)



*Principal Designer:*  
Doug Schwandt, MS

*Bicycle Frame Builders/Designers:*

Keith Bontrager  
Gary Hale  
Peter Johnson  
Tim Paterek  
Chris Schwandt

*Other Significant Design Contributions:*

Gordon Abraham, MS  
Jim Anderson, JEM  
Peter Axelson, MS  
Phil Barkan, PhD  
Irv Housinger  
Larry Leifer, PhD  
Candy Mintz, PhD  
Fred Tatch

# Handbike Arm-Powered Bicycle



## Features

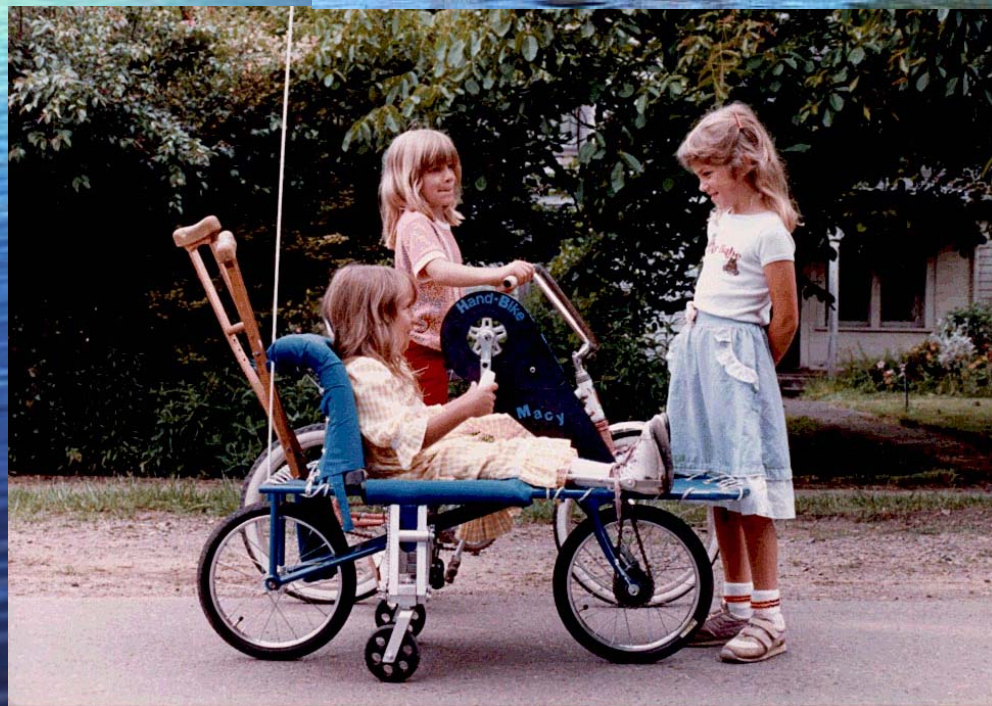
- **Arm-Powered Bike for People with Lower Limb Disability**
- **Adjustable Side-Wheels up for Two-Wheeling and Fasten Down for Transfer**
- **Multiple Gears**
- **Folding Crank Tower for Easy Access**
- **Steer to Balance**

## Applications

- **Recreation, Transportation, Competition, Exercise**

## Commercialization

- **Recreational Mobility Inc. (1983-1984)**
- **New Dimensions Design, Inc. (1992-1996)**
- **Mobility Engineering, Inc. (1996 - present) [www.mobilityeng.com](http://www.mobilityeng.com)**









Principal Designer:  
Doug Schwandt, MS

# Sunburst & Handbike Tandem

Bicycle Frame Builders/Designers:

Gary Hale  
Keith Bontrager

Significant Design Contributions:

Jim Anderson, JEM

British Columbia Collaborators:

Marshal Smith, Provincial Prog  
Admin, Disabled Athlete  
Kate Hunter-Zaworski, PhD  
Shayna Hornstein, PT



Photo: Bruno Schlumberger, *The Citizen*, Ottawa, Ontario, Rehabilitation Engineering Society of North America conference, June 19, 1984.

## Features

- Arm/Foot-Powered Bike for Able-Bodied and Disabled to Share
- Separate Gearing for Recumbent Front Rider
- Upright Rider in Back Steers
- Not Only for Disabled Riders
- Easy to Communicate and See Ahead

## Applications

- Recreation, Transportation, Competition, Exercise

## Collaboration

- British Columbia Provincial Program for 1981 International Year of the Disabled Program thru Univ BC

## Unrelated Commercialization

- CounterPoint Conveyance, Inc.
  - Jim Weaver
- Viewpoint Tandem
  - Bilenky's Cycle Works Ltd. ViewPoint
  - <http://www.bilenky.com/index.htm>



Investigators:  
Scott Parazynski, MD (Astronaut)  
Alan Hargens, PhD

Design/Fabrication:  
Doug Schwandt, MS  
Jim Anderson, JEM  
Donna Hooker (JSC Contractor)  
Maurice LeBlanc, MS CPO  
Lin Liang, PhD  
Russ Hays

**NASA-VA Collaboration:**

- **Space Exercise (NASA)**
- **Rehab Exercise Potential (VA)**

# Inter-Limb Resistance Exercise Device



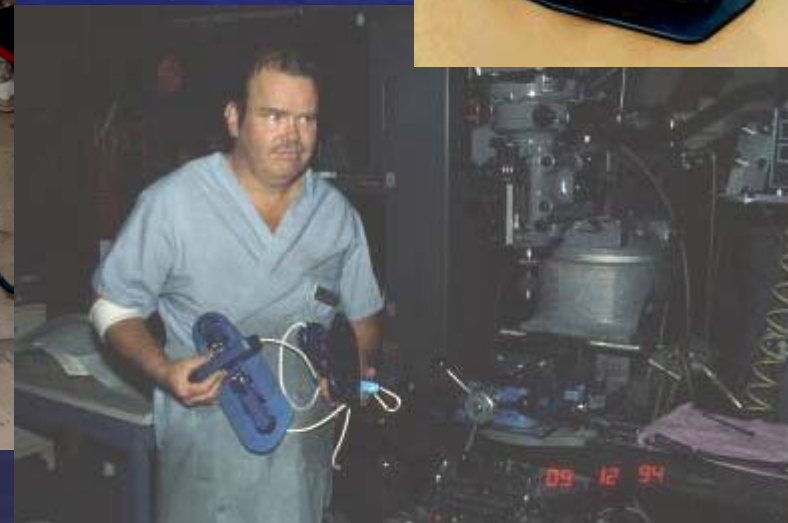
**Tests On-Board NASA's  
KC-135 Parabolic Flight  
Microgravity Simulator**



**On-Board STS-66 space shuttle launch**



**Jim machines ILR  
flight hardware**



Principals:

David Brown, PhD

Edward Colgate, PhD

Michael Peshkin, PhD

Clinical/Marketing:

Ela Lewis, MSPT, NCS

James Patton, PhD

Rehab Institute of Chicago

Engineering/Design:

Julio Santos-Munne'

Director of Engineering

Alex Makhlin, MS

Tom Moyer, MS

Douglas Schwandt, MS

Concept Development & Human

Interface Design:

IDEO (Evanston)

# KineAssist™ -- Assistive Device for Physical Therapy



## Features

- Assist clinicians in gait & balance training, in a functional context.
- Challenge clients to their maximum limits without increasing the risk of falls.
- Maintain consistency with current practice and infrastructure.
- Allow more therapy, by minimizing set up time.
- Will be used during transition, standing balance, ambulation and dynamic balance therapy.

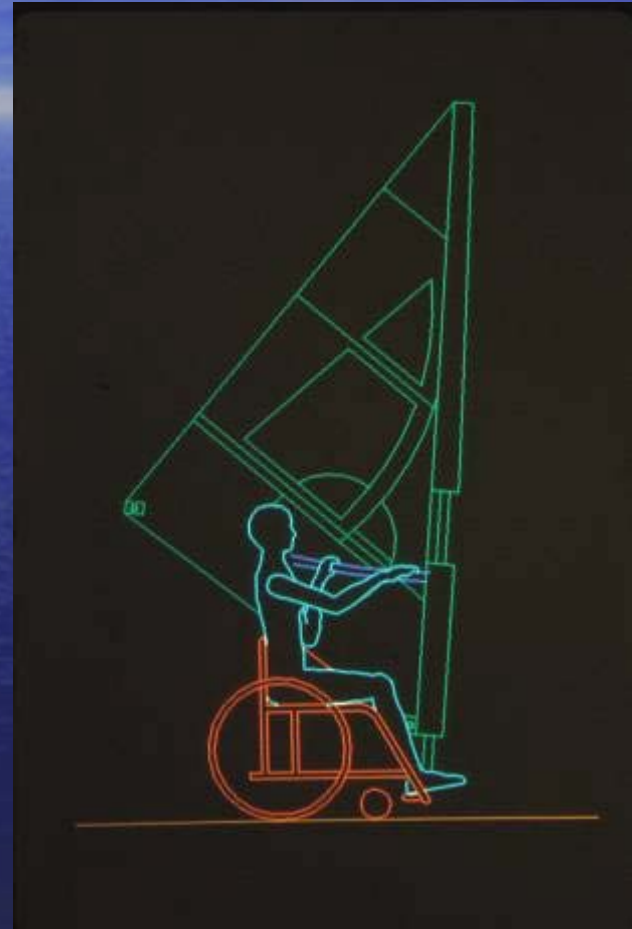




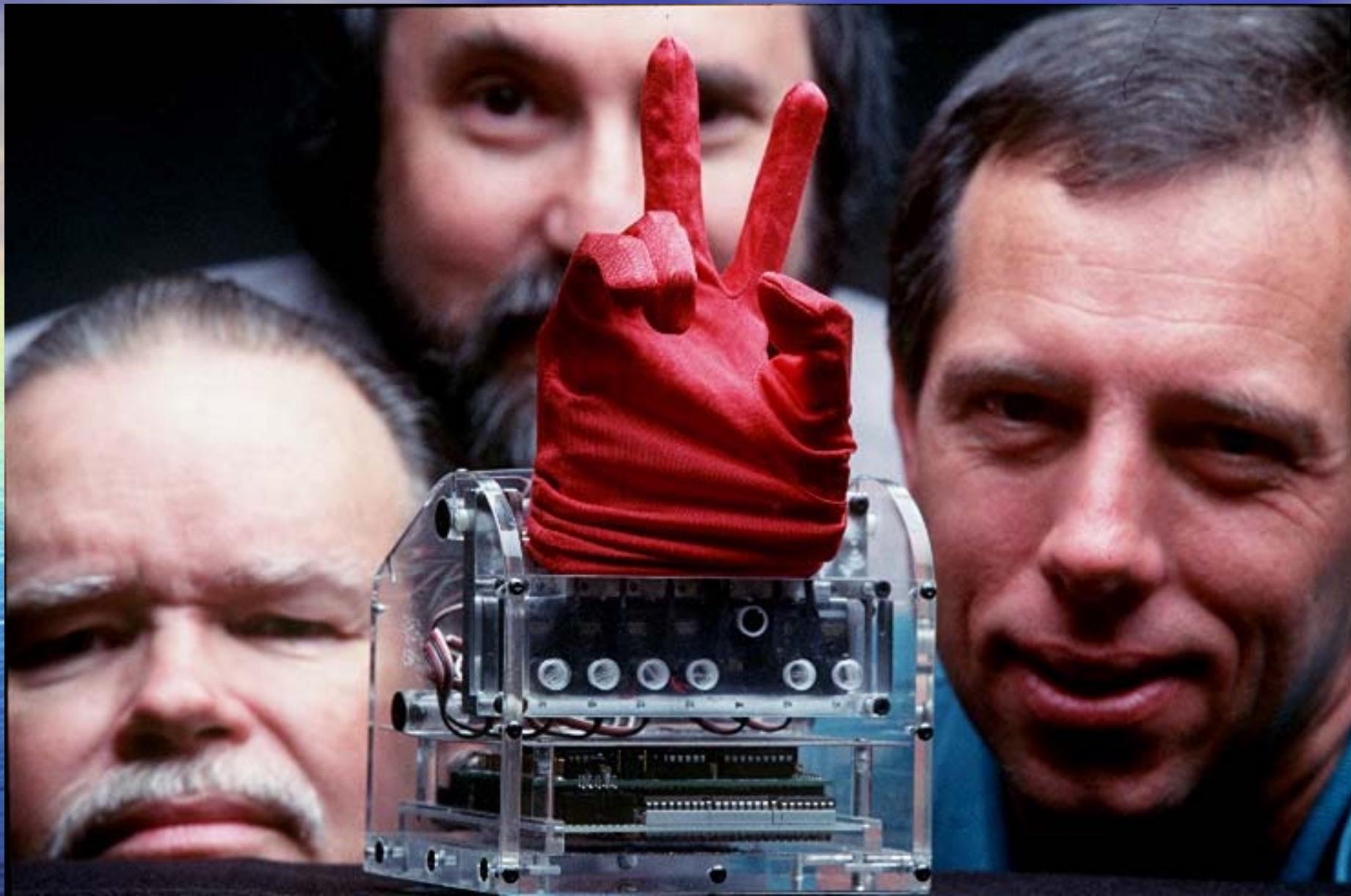
# Perspective

- Involve the client throughout the design process!
- Use the tools (SolidWorks, Skype, Internet, etc.).
- Review your notes and continue to learn.
- Work in a team – stay flexible - consult the experts.
- “Don’t bite off too much.”
- “Mt. Everest is climbed one step at a time.”
- “Never enough time to do it right – always enough time to do it over again.”
- “No quick and dirty – the quick is soon forgotten, and the dirty lives on and on.”
- Quotes mostly from Jim Anderson, Journeyman Experimental Machinist, champion rehab machinist.

# Windsurfing Wheelchair







**Jim Anderson, Dave Jaffe and Doug Schwandt with Ralph.**  
Photo/article: Bob Frost, "Helping Hand," West magazine, San Jose Mercury News, May 2, 1999.