DEPARTMENT OF BIOMEDICAL ENGINEERING
University of Wisconsin

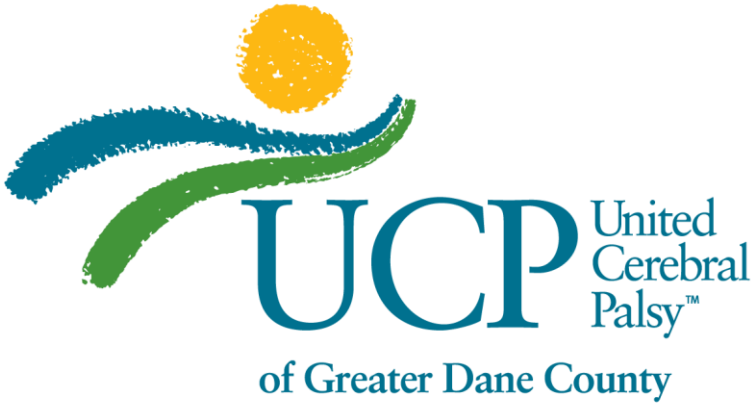
U-Cube Physical Therapy Unit

Jon Elicson, Sam Mešanović, Jake Kanack, and Jon Leja

Client: Matt Jahnke
Adviser: Dr. Saha

Client, Therapist, and Patient

- Matt Jahnke
  - Adult Program Director at United Cerebral Palsy of Greater Dane County
- Amanda Miller
  - Occupational Therapist
- Roberto
  - Traumatic brain injury (TBI) victim



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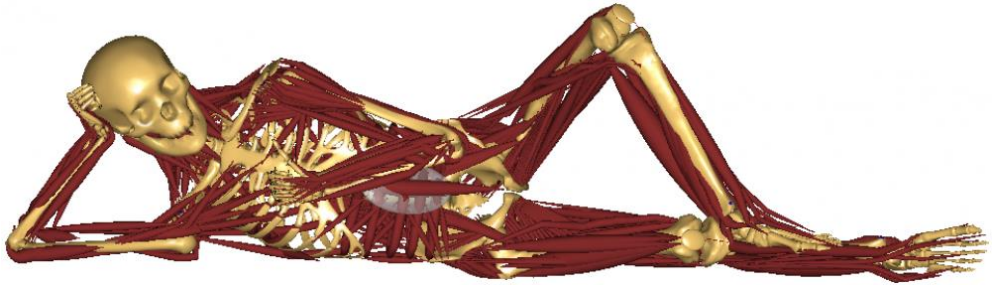
Outline

- Background
- Problem statement
- Previous work
- This semester’s goals
- Design ideas
- Final design
- Future Work
- References



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Background on TBIs

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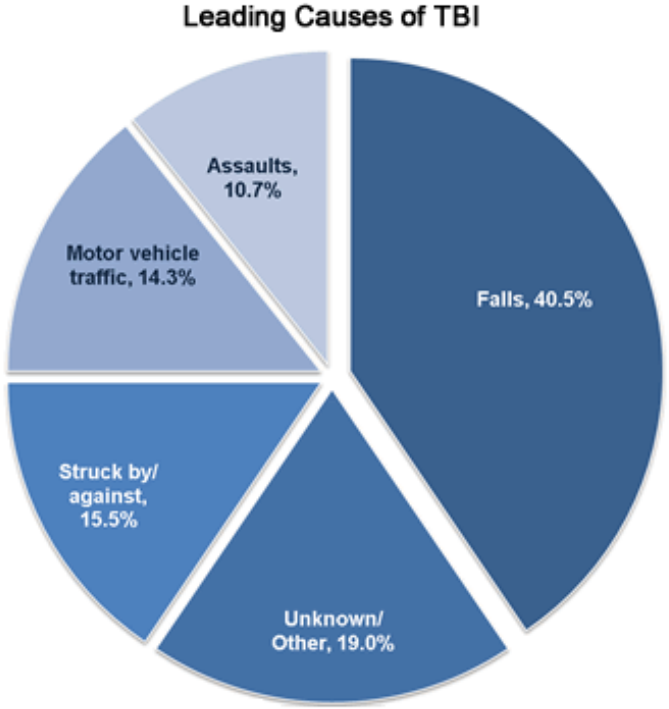
- 2.5 million TBIs in 2010
  - Ranging from mild to severe
  - Can be either “closed” or “penetrating”
  - $76.5 billion in medical care

- 5.3 million Americans have a TBI related disability
  - Results in decreased physical and cognitive abilities



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Current Designs

- Universal Exercise Units
  - Allow for muscular isolation
  - Commercially available
    - Prohibitively expensive (~$5,500/unit)

- UEU- Suspension accessories
  - Belt- $250
  - Bungee cords- $120 for set of 8
  - Accessories set- $1750

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Problem Statement

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- Create and test an intensive therapy unit to elastically suspend a patient at a reduced cost
  - Accomodate patients of varying specifications
  - Prototype will be placed at the Madison Area Rehabilitation Center
- Design a suit for use with our cage prototype
  - The suit must be adjustable and have good weight distribution
- Create an instructions manual and parts list
  - Use “off the shelf” materials and household tools

Previous Work

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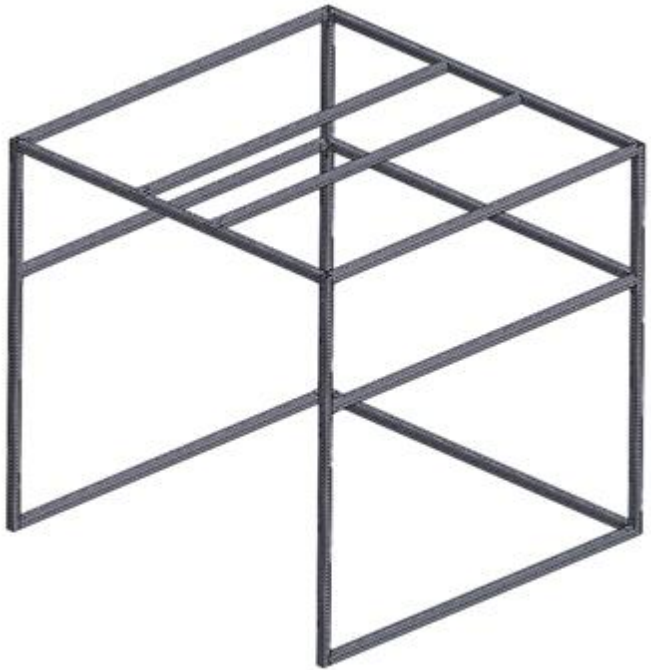
- Designed U-Cube last semester
  - Total estimated cost ~$1000
  - 8’x8’x8’
  - Open face for entry
  - 90 degree bolted joint fittings
- Previous members: Austin Gehrke and Taylor Marohl



This Semester's Focus

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- Either create or integrate a commercially available suspension suit into our design

- The suit must provide dynamic suspension capabilities
  - Capable of suspending 250 lb
  - Capable of being adjusted to accommodate different individuals
  - Capable being adjusted to accommodate various physical ailments

Design Idea 1: DLX Harness

- Even weight distribution around waist
  - adjustable, 28”-50” waist
  - padded waist
  - 300 lb load (136 kg)
- Limited overhead suspension
  - Only two load bearing loops
- Price: $499

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Design Idea 2: The Seat

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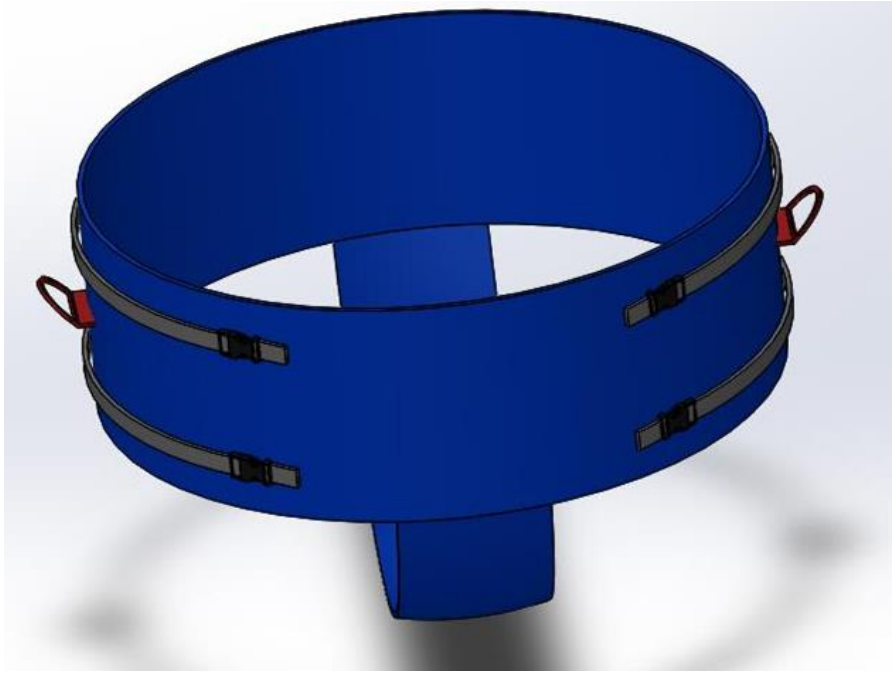
- Construction
  - Nylon webbing
  - Steel D-rings
  - Neoprene lining
- Groin and waist suspension
- Lower cost, but requires custom fabrication



Buckle Models Credit Tim Smith

Design Idea 3: The iHarness

- Commercial product ($1500)
- Creates biomechanically-appropriate posture
- Breathable, soft, and flexible
  - Fits 84” girth
  - Allows full hip extension

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Design Matrix

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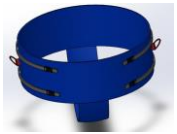
Design: **Criteria (weight)**	DLX 		Seat 		iHarness 	
Physical Support / Distribution of Weight (25)	4/5	20	3/5	15	4/5	20
Comfort (20)	5/5	20	3/5	12	4/5	16
Ease of Use (20)	4/5	16	4/5	16	3/5	12
Adjustability (15)	3/5	9	3/5	9	4/5	12
Safety (10)	5/5	10	2/5	4	4/5	8
Cost (10)	4/5	8	5/5	10	1/5	2
Total (100)	**83**		**66**		**70**	

Final Design: DLX Harness

- Even weight distribution around waist
  - Adjustable, 28”-50” waist
  - Padded waist
  - 300 lb load (136 kg)
- Limited overhead suspension
  - Only two load bearing loops
- Price: $499

Integrating the DLX into our cage

- May want to sew in additional load bearing loops
- Create knee pads or elbow pads for additional support
- Possibly integrate a chest support piece

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Future Work

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- Perform structural analysis
- Secure funding- Bellows Grant
- Perform weight bearing analysis on harness
- Integrate harness into the cage
- Purchase materials and build prototype
- Design and publish instruction manual

Acknowledgements

- Dr. Saha (advisor)
- Mr. Jahnke (client)
- Amanda Miller (therapist)
- Roberto (client’s client)
- Dr. Meyerand (previous advisor)
- Andrew (previous client’s client)

References

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