Anatomical Model Propulsion System (AMPS)

Measuring Manual Wheelchair Efficiency

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PROJECT GOALS

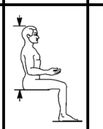
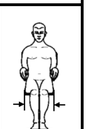
The goal of this project was to produce a test device and methodology capable of measuring the mechanical efficiency of manual wheelchairs. The result would provide an objective measure of wheelchair performance that are required to effectively prescribe wheelchairs and to code wheelchairs properly for reimbursement.

DESIGN CRITERIA

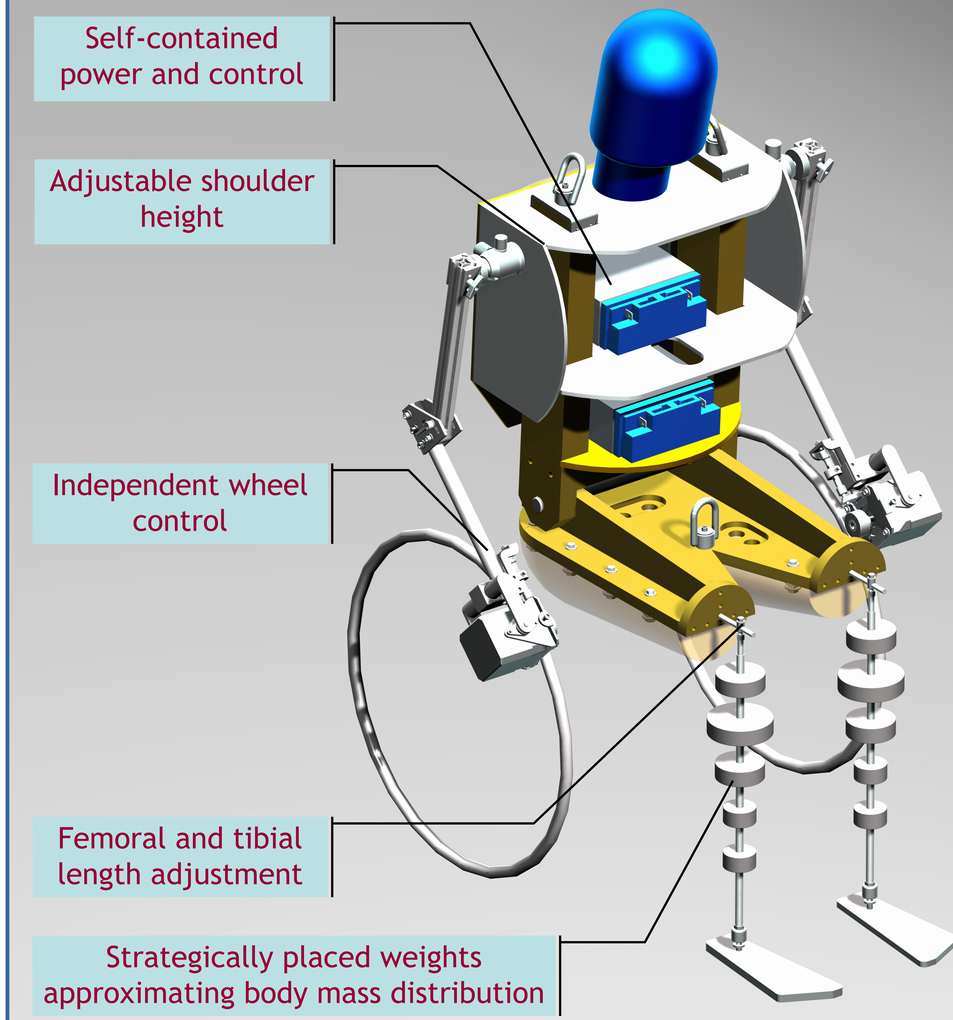
1) Adjust to different wheelchair configurations (e.g. camber, axle location, pushrim size, wheel dia.,…)
2) Replicate loading as seen by the wheelchair
3) Perform prescribed maneuvers autonomously
4) Manifest human inertial characteristics
5) Measure work input and energy output over time

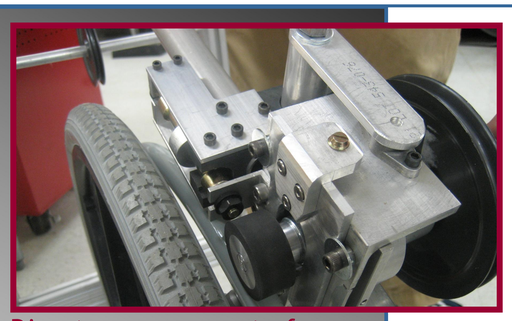
AMPS CHARACTERISTICS

Key measurements for anthropometric similarity:

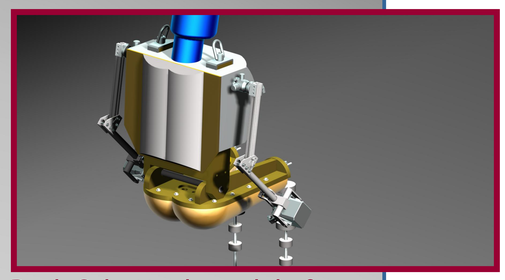
Buttock to Popliteal Length	Midshoulder Height	Popliteal Height	Sitting Height	Hip Breadth
				
19.5 in.	22.9 in.	17.3 in.	35.7 in.	16.3 in.

AMPS parameters are derived from ISO 7176-11 100kg dummy and Hybrid III 50% male ATD segment length.

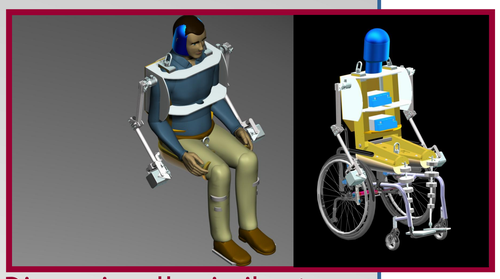




Direct measurement of tangential force

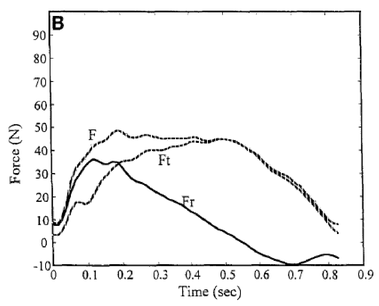


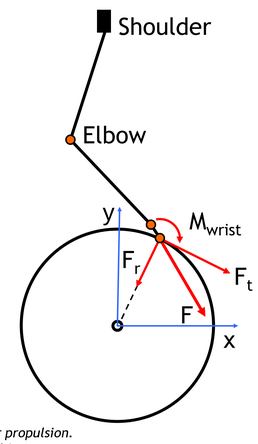
Back & buttock models for realistic load distribution



Dimensionally similar to 50% male ATD

PUSHRIM FORCING





Robertson, R.N., et al., *Pushrim forces and joint kinetics during wheelchair propulsion.* Archives of Physical Medicine and Rehabilitation, 1996. 77(9): p. 856-864.

CANONICAL MANEUVERS

Work input and energy output measured over several fundamental maneuvers, e.g.

- Accelerate from stop to 1.2 m/s in 3 seconds then decelerate to a stop
- 180° T-turn
  - Reverse turn about left wheel for 90°
  - Stop
  - Forward turn about right wheel for 90°

FUTURE WORK

- Validate tangential force measurement subsystem
- Obtain propulsion force profile from SmartWheel
- Complete AMPS construction
- Test AMPS over canonical maneuvers to determine figures of merit
- Fine tune AMPS design and test methodology based on feedbacks from industry advisors

ACKNOWLEDGEMENTS

This research was conducted as part of the RERC on Wheeled Mobility, which is supported by Grant H133E080003 from the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education.

I owe my gratitude to my advisors and the rest of the AMPS team for their continued support and contribution to this project.

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