NHS Funded National Institute for Health Research
Invention for Innovation (i4i) Project

Presenters: Catherine Holloway and James Speedy

Title: Development of a new force sensing handrim for everyday use

Category: Development & Challenges in Wheelchair Services

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Development of a new force sensing handrim for everyday use

Outline

- Wheelchair user injuries
- Everyday outside environments
- Need to measure forces generated by users
- PowerWheel
  - Design aims
  - Validation methods
- Testing at PAMELA
- Results & future work

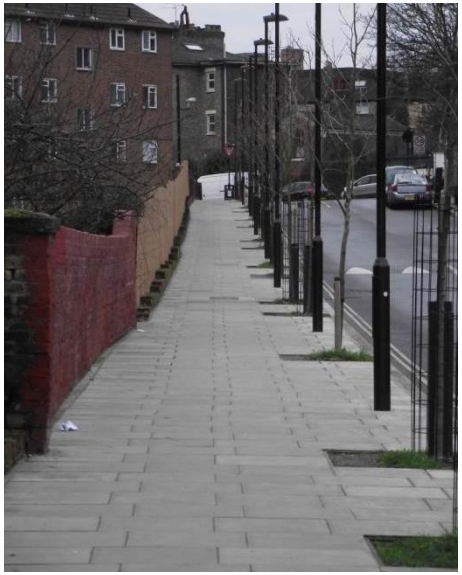
Injuries

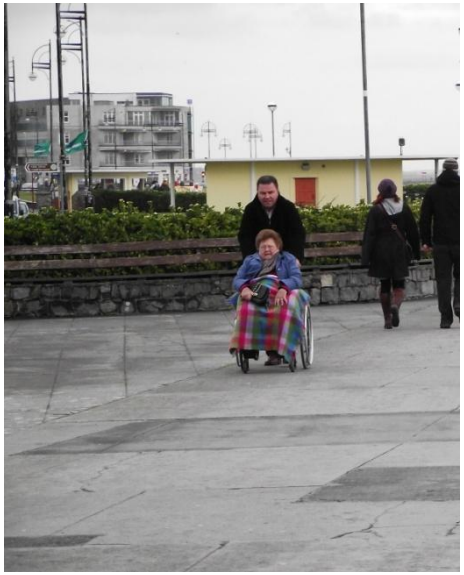
- Injuries:
  - Wrist: Carpel tunnel syndrome
  - Shoulder: impingement syndrome & tears in the rotator cuff
- Lead to:
  - Debilitating pain
  - Lower quality of life
- Linked to:
  - Short hard pushes

Solution: To push with longer smoother strokes

Outside environment

What in the outside environment causes short sharp pushes?





How do we know what causes wheelchair users injuries?

- Ask people:
  - focus group
  - Questionnaire

+ individual description
+ Large sample size
- Subjective

- Measure handrim forces:
  - Smartwheel
  - Optipush

+ Detailed biomechanical analysis
- Heavy
- Expensive
- Limited to clinics

PowerWheel: Design aims

- Rim-mounted measurement wheel
- Wireless feedback for clients and clinicians
- Light
- Cheap

PowerWheel: Validation

- Benchmark against current industry standard (SmartWheel)
- Detect differences between people and different everyday obstacles

Validation Experiments

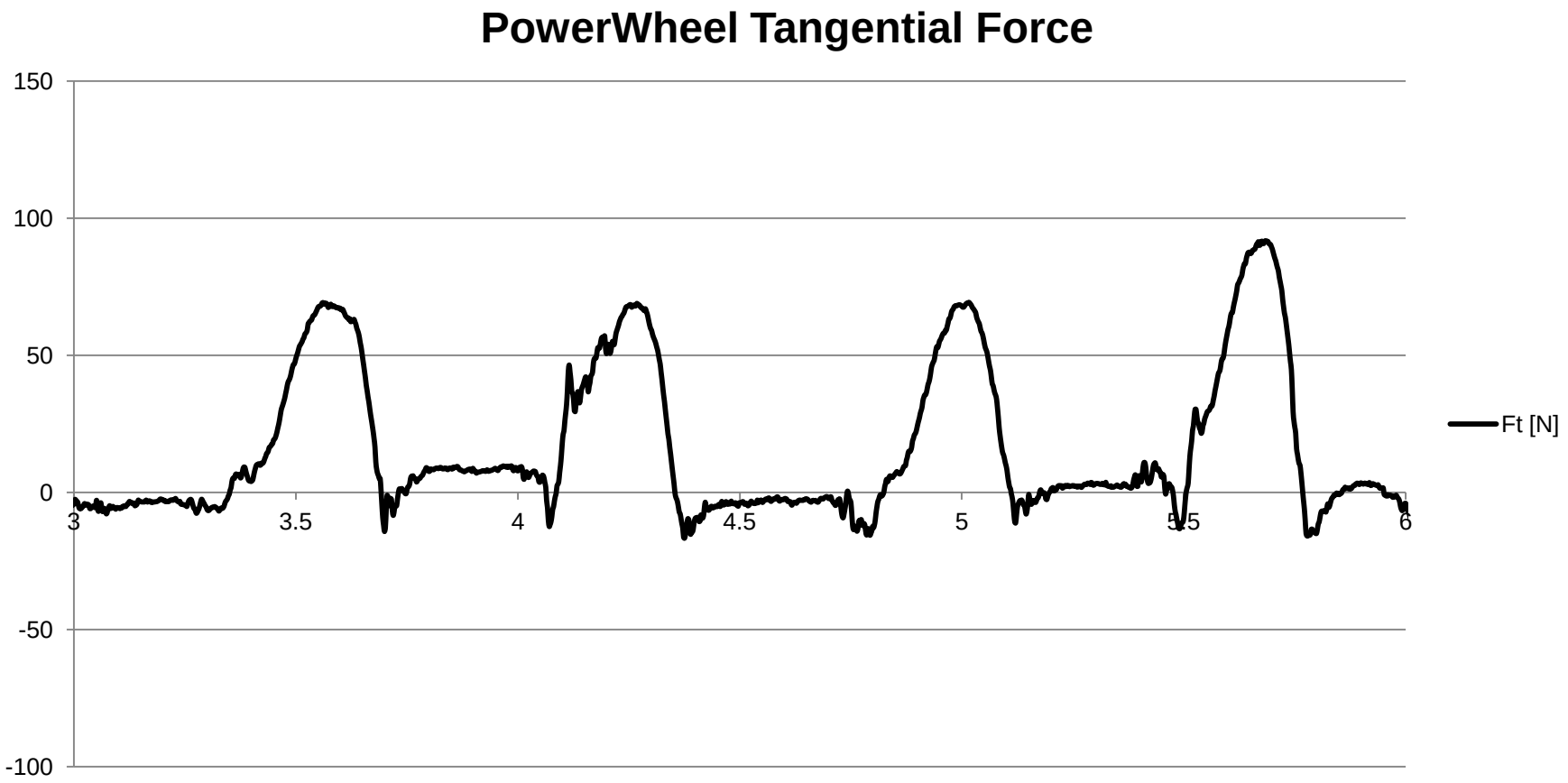
- Bilateral data
  - PowerWheel (left-hand side)
  - SmartWheel (right-hand side)
- 3 able-bodied subjects
- Everyday environments set up at the PAMELA facility
  - Crossing a road, going up a ramp, along a footway

PAMELA

Includes

- A static adjustable platform to simulate different surface profiles & types and arrangements of obstacles
- A variable lighting system
- An ambient and localised sound system
- Vision and hearing testing equipment
- Observation systems
- Monitoring systems
- Data extraction systems
- To be used with pedestrians and users of small vehicles (scooters)

Results: PowerWheel Force



Outcomes & Next Steps

- Results
  - Comparable results to the SmartWheel
  - Able to see differences between different environments
- Next Steps
  - Make the PowerWheel more robust
  - Allow streaming to mobile phones
  - What else?

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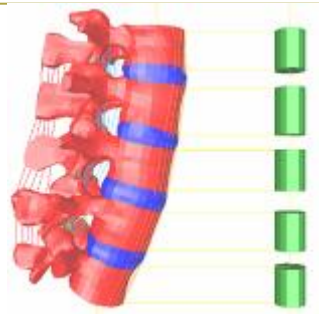
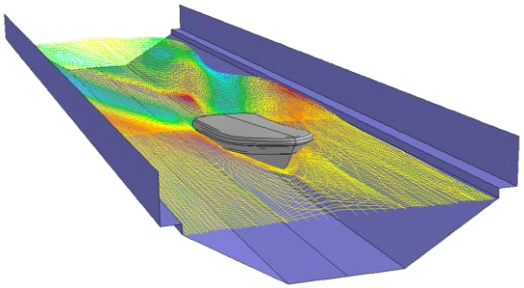
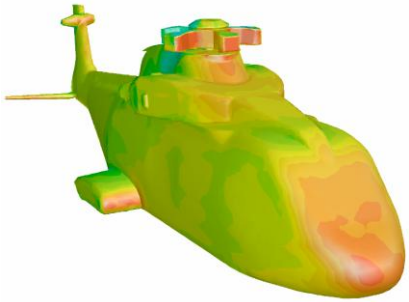
Frazer-Nash Services Applicable to Medical Industry

- Mechanical Design
- Structural Analysis (Static & Dynamic)
- Software
- Human Factors
- Fluid and Heat Transfer
- Noise and Vibration
- Systems Engineering
- Safety and Environmental
- Electrical – C&I

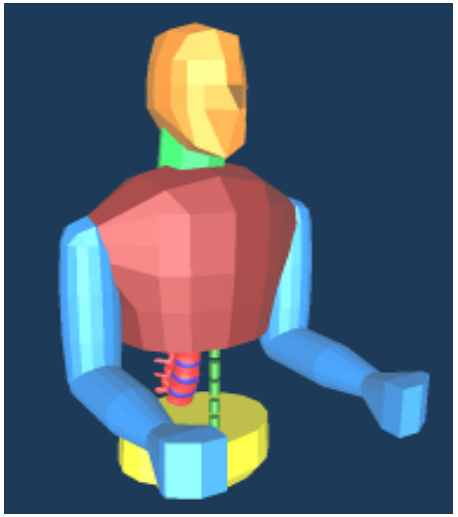


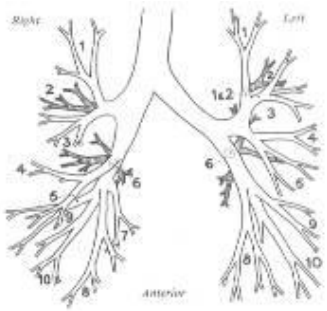


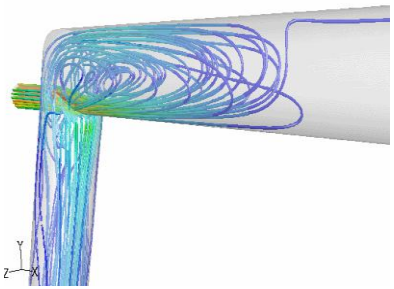


Medical Experience

- Novel Rehabilitation Equipment Design
- Ambulance Assistive Device Design
- Wheelchair Monitoring
- Spinal Injury Modelling
- Drug Delivery
- CPAP Device Design
- Impact Injury Assessment
- Plume Dispersal
- Orthopaedic Implants







Opportunities and Collaborations

- We are always looking for interesting project opportunities and collaborations that utilise our core capabilities in:
  - Requirements capture and Design specification
  - Concept generation and evaluation
  - Product innovation and strategy
  - Engineering design and prototyping
  - Structural and Dynamic Analysis
  - Process optimisation and Supplier selection
  - Test design, manufacture, execution and analysis
  - Feasibility and design audit studies
  - Risk and Safety analysis – product and project
  - Software development and management
  - Mathematical modelling – FEA and CFD
  - FMECA – design and process
  - Due diligence