Project Continuum:  
Upper Extremity Exoskeleton for Individuals with Duchenne Muscular Dystrophy  

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Design of Passive Arm Support: Range of Motion
Design of Passive Arm Support: Size
Design of Passive Arm Support: Forearm Cuff

NJIT
New Jersey Institute of Technology

Parent Project Muscular Dystrophy
LEADING THE FIGHT TO END DUCHENNE

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Design of Passive Arm Support: Storage
Evaluation of Passive Arm Support (n=30)

Reachable workspace evaluation (Dr. Kurillo and Dr. Han, et al.)
Evaluation of Passive Arm Support

While making the reachable workspace movements while unsupported, please rate the exertion level required for you to complete the movements (mark your answer on the line):

Least amount of effort  Most amount of effort

While making the reachable workspace movements with the passive arm support, please rate the exertion level required for you to complete the movements (mark your answer on the line):

Least amount of effort  Most amount of effort

Task: Ping Pong
Weight:

Arm support (check one):
☑ Passive arm support
☐ Vertical assist arm support

Please answer the following questions based on your ability to perform the priority task while unsupported and while supported by the arm support.

UNSUPPORTED
When the arms are unsupported, can you perform this task with some ability or no ability (choose one)?

Some Ability  No Ability

PASSIVE ARM SUPPORT
Could you perform your priority tasks to a satisfactory level while your arms were supported by the passive arm support?

YES  NO

If you answered yes to the previous question, how would you rate your achievement of the priority task while supported by the passive arm support compared to when your arms were unsupported (choose one)?

A lot better  A little better  The same

If you answered no to the previous question, choose one:

No Ability  No Ability
Admittance control is well suited for use by individuals with DMD

1. **Assistance against gravity** more precise than passive arm supports to increase active range of motion.
2. **Minimize friction and inertia** so the user can control a large, powerful robot with limited muscle strength
   - Reduces overall force required to generate a movement
   - Set parameters based on capabilities of user, change over time to accommodate changes in muscle strength
3. **Mimics passivity** making control intuitive and inherently safe
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Admittance control to Increase Active Range of Motion

Unsupported  Passive Arm Support  Admittance Control

NJIT/Kessler Foundation RERC on Wearable Robots – NIDILRR
Gustavus and Louise Pfeiffer Research Foundation Grant
Admittance Control to Increase Independence in Activities of Daily Living

Subject-Reported Exertion Level Scores for Unsupported and HapticMASTER Supported Performance of Priority Tasks

Mean

Error Bars: +/- 1 SE

Unsupported
HapticMASTER

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Motorization: Vertical Assist Kit

Passive arm support → Vertical assist kit → Horizontal assist kit → Rotational assist kit
Project Timeline

Complete
• Design and fabrication of passive arm support

Ongoing
• Outfit 30 users with passive arm supports

Ongoing
• Development and testing of vertical assist module

6 months
• Outfit users with vertical assist module

Ongoing
• Monitor user functional status and device functionality over time
Future Direction

Loss of Upper Extremity Function = DMD Progression + Secondary Factors

**Fully motorized, modular** admittance control arm support

- **Augment lost function** by increasing independence in activities of daily living
- **Preserve functional abilities** by reducing secondary factors
  - Disuse atrophy, contractures, posture and scoliosis
Our Team

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Blake Mathie
Commercial Partner
Talem Technologies

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Dissemination Consultant

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