Quantifying Abnormal Muscle Tone Due to Neurological Impairment

Thursday March 20th, 2014
Starts at 12:00 PM EST
Presented by
Elizabeth Brokaw, PhD

GREAT LAKES NEUROTECHNOLOGIES

Kinesia HomeView™

Kinesia ProView™

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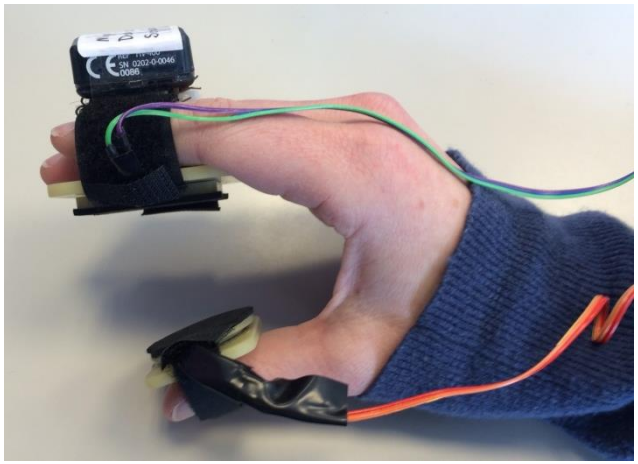
MyoSense



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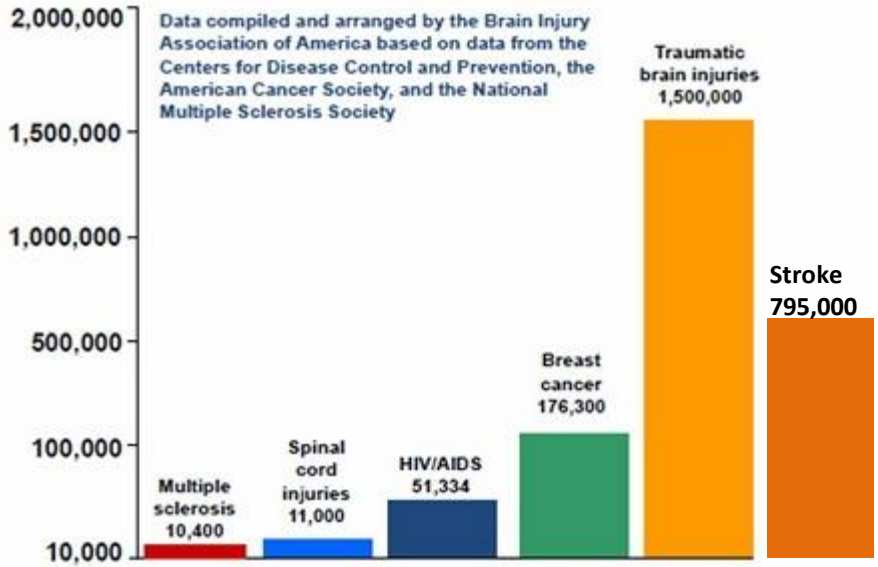
Outline

- Impact of Neurological Impairment
  - Abnormal Muscle Tone
- MyoSense
  - Development
  - Bench Testing
  - Clinical Evaluation

Individuals With Neurological Impairment

- High incidence of neurological disorders
  - Abnormal muscle tone
  - Reduced independence



Center for Disease Control; Jan 2006 *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths, 2002-2006*

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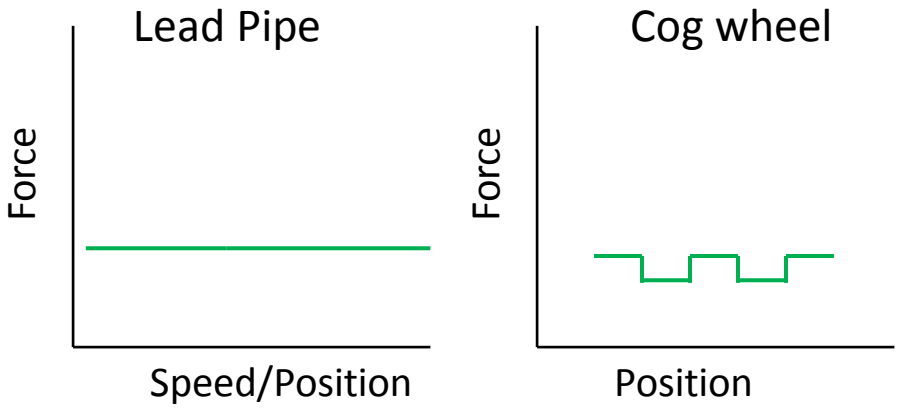
Abnormal Muscle Tone

- Resistance force to passive movement
- Abnormal muscle tone presents in many different forms.
  - Rigidity
  - Dystonia
  - Spasticity
  - Hypertonia

Rigidity

- Parkinson's Disease
  - Stiffness or heaviness
    - Lead pipe
    - Cog wheel



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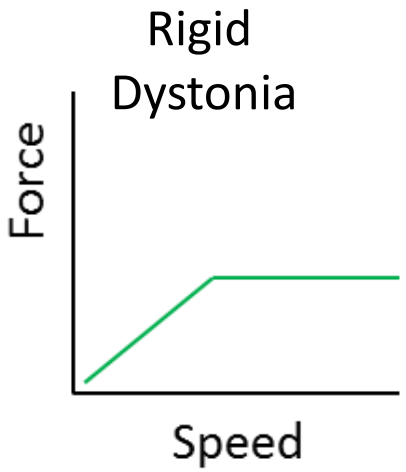
Dystonia

- Cerebral Palsy
  - Rigid/Posturing
  - Unintentional movement



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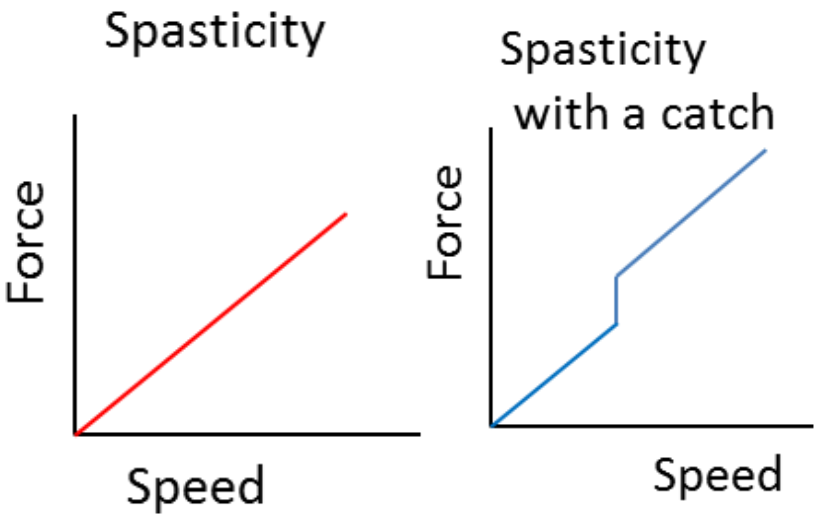
Spasticity

- Stroke and Traumatic Brain Injury
  - Speed based
  - Catch



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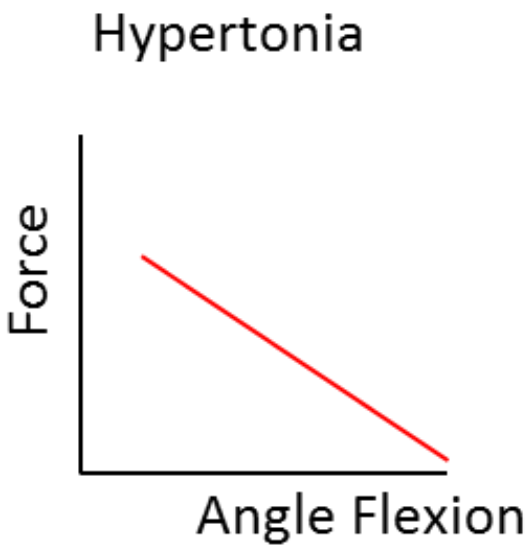
Hypertonia

- Stroke and Traumatic Brain Injury
  - Range of motion



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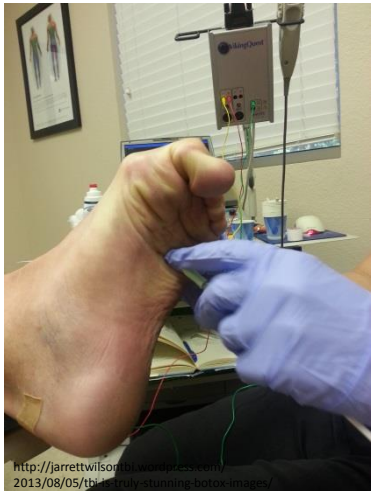
Treatments

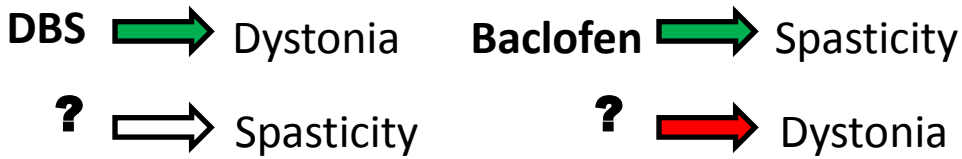
- Various types of treatment
  - Botox
  - Baclofen
  - Phenol injections
  - Surgical intervention
  - Deep brain stimulation



Issues with Abnormal Tone Management

- Abnormal tone types respond differently

- Difficult to distinguish different types of tone
  - Cerebral palsy



- Research limited by current clinical outcome measures

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Clinical Scales

- Specific aspects of abnormal tone
  - Modified Ashworth, Tardieu (spasticity)
  - Fahn Marsden Burke (dystonia)

FMB Arm Evaluation

0	No dystonia present
1	Slight dystonia. Clinically insignificant
2	Mild. Obvious dystonia but not disabling
3	Moderate. Able to grasp, with some manual function
4	Severe. No useful grasp

- Low resolution
- Subjective interpretation

MyoSense Development

- Quantitative assessment of abnormal tone
- Integrate with conventional practice
  - Clinician worn
    - Reduce patient burden
  - Typical Assessment
    - Speed
    - Position
    - Force

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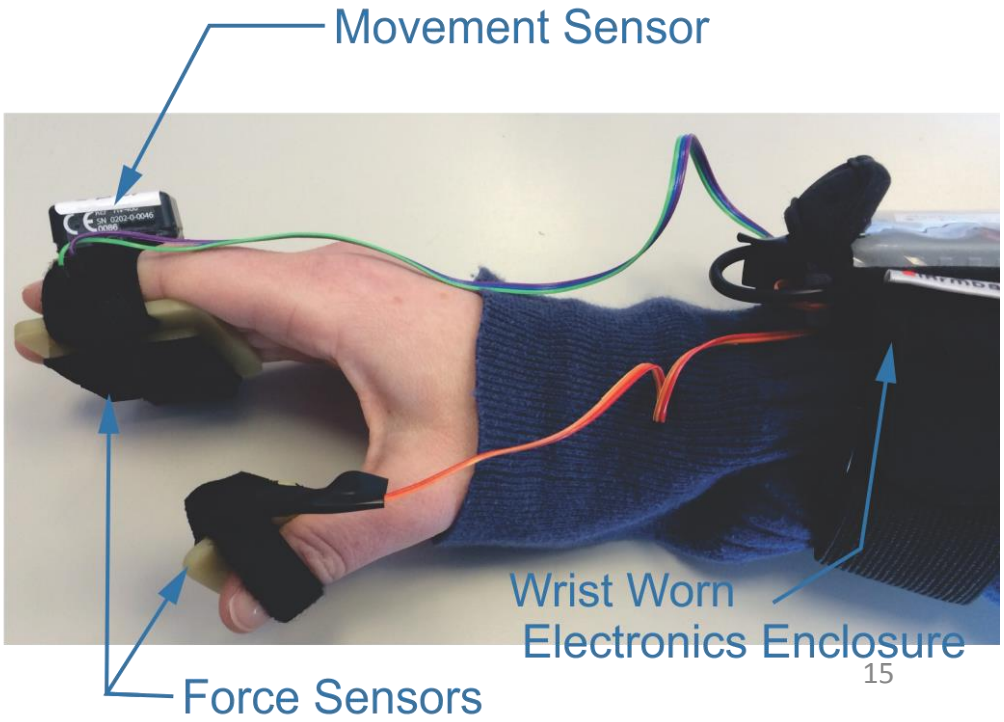
MyoSense

- Prototype Hardware
  - Flexiforce FSR sensors and XBee
  - GLNT Movement Sensor (bluetooth)



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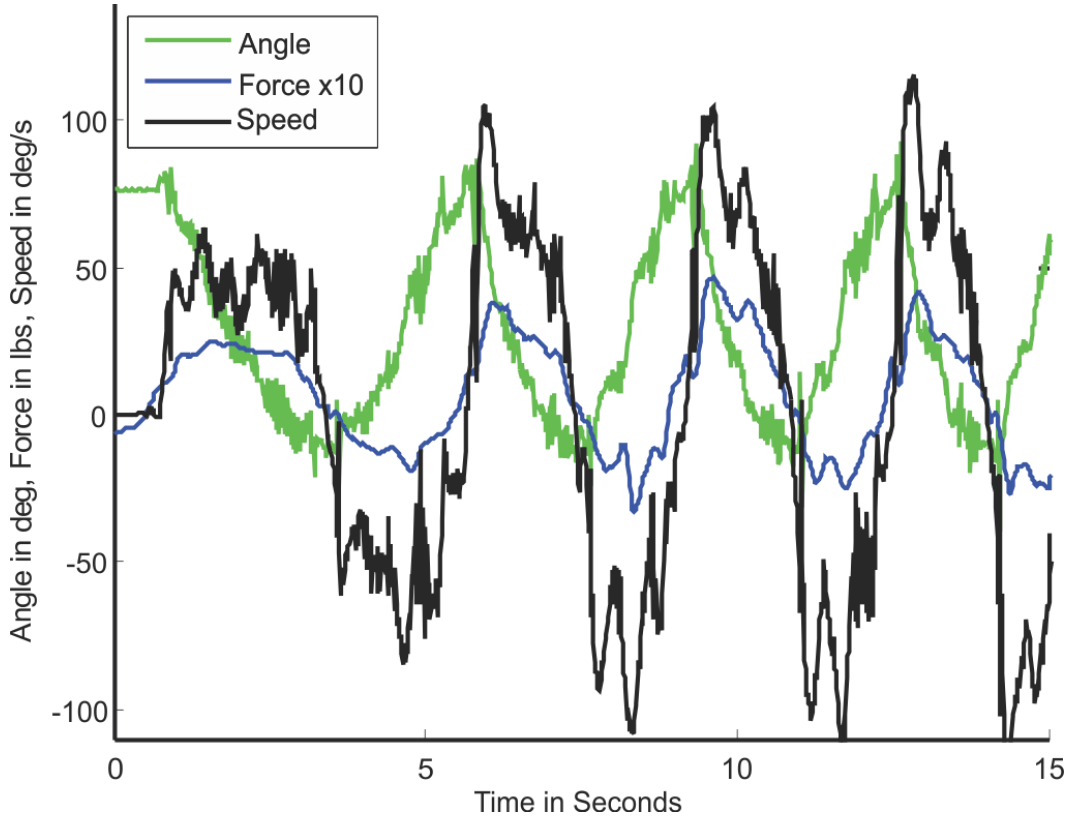
MyoSense Data

- Information about orientation and speed
- Correlate with force data



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MyoSense Bench Testing

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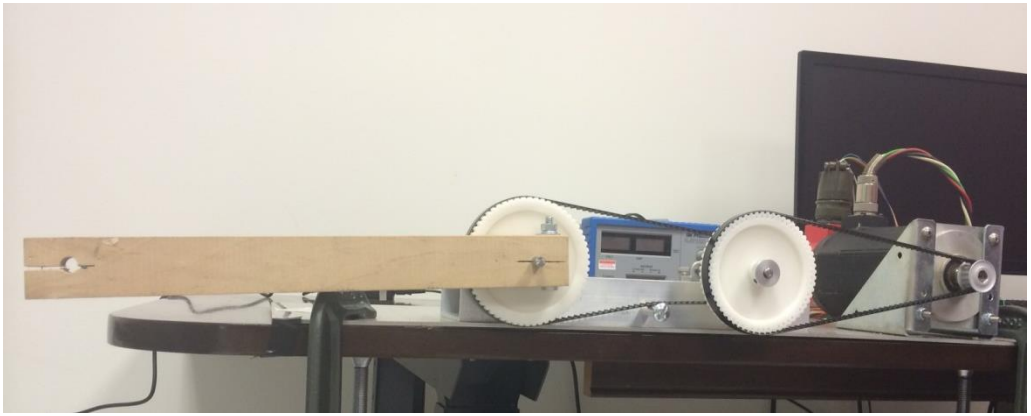
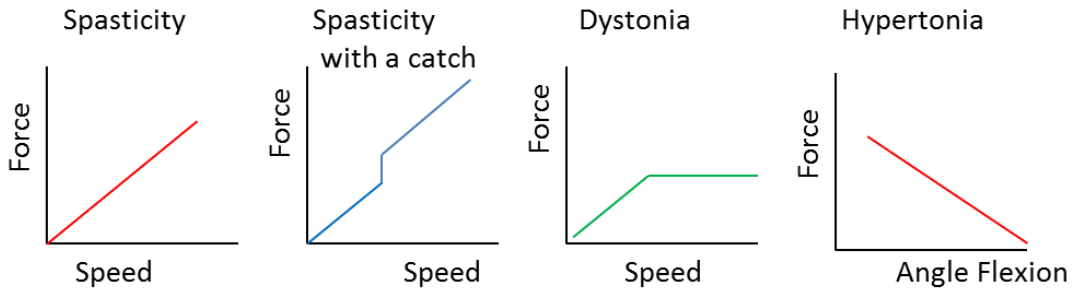
Simulated Abnormal Elbow Tone





Threshold set at 45 deg/s

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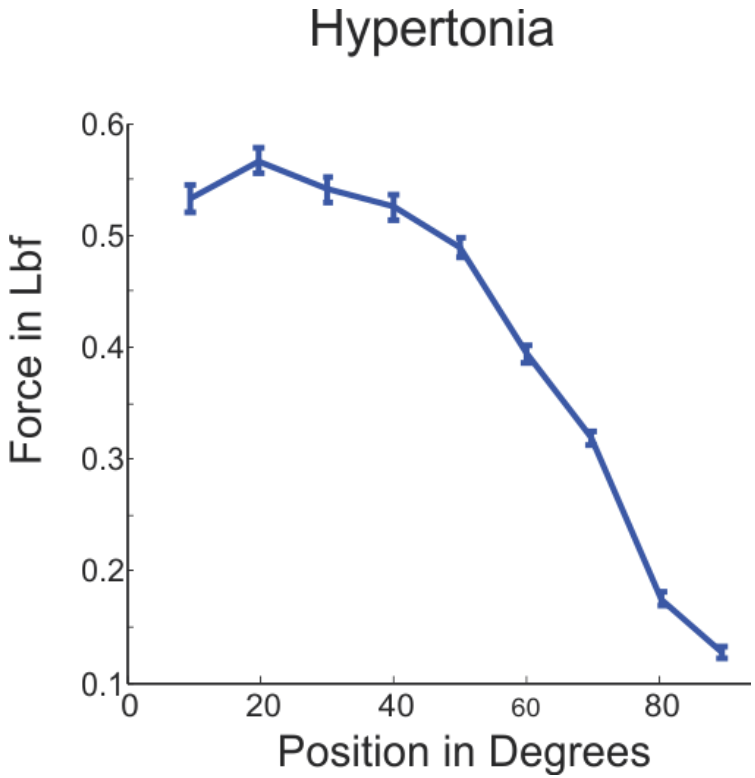
Distinguishing Profiles

- Hypertonia Evaluation
  - Move the simulated elbow at 5 deg/s
- Position bins and average force
- Correlation to theoretical = 0.93



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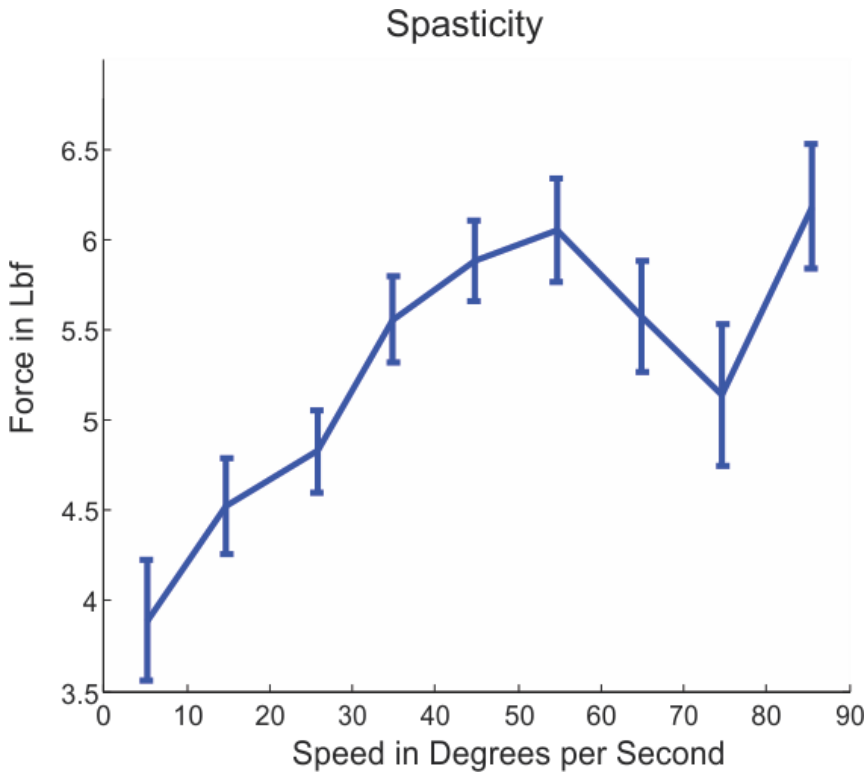
Distinguishing Profiles

- Mod-Ashworth Evaluation
  - Move the simulated elbow at 90 deg/s
- Speed bins and average force
- Correlation to theoretical = 0.80
- High speed effects of device mechanics
  - Belts and filtering



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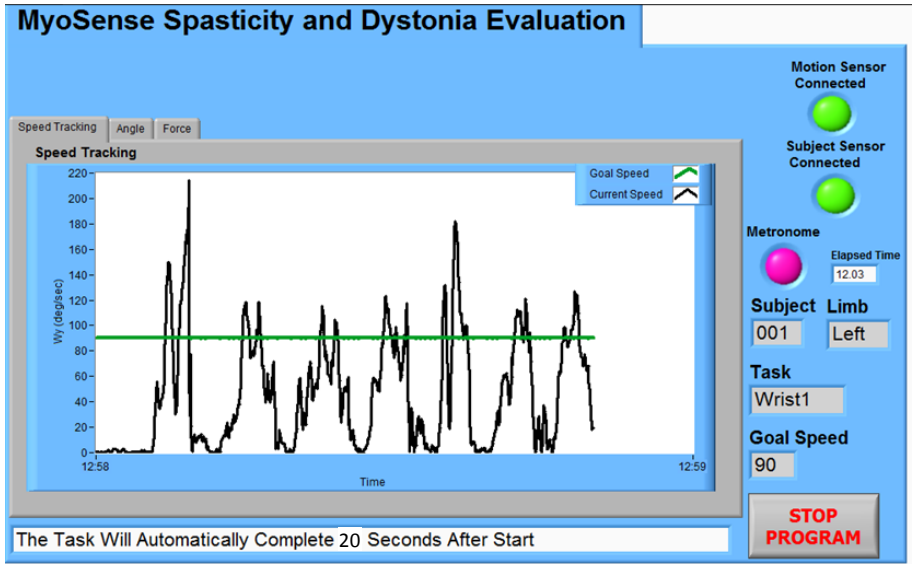
Comparing Different Abnormal Tone Profiles

- Issue
  - High speed mechanical effects
  - Acceleration
  - Change in direction
- Solution
  - Track specific speeds
  - Examine the change across speed

Comparing Different Abnormal Tone Profiles

- Tracking specific speeds
  - 5, 25, 45, 65, 85 deg/s

- At each 20s trial
  - Average speed and average force



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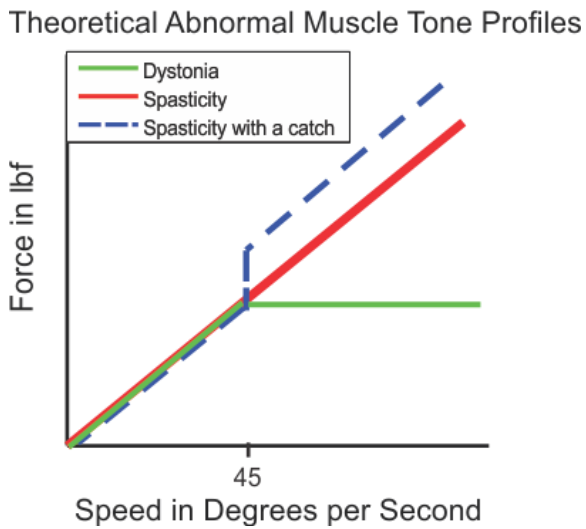
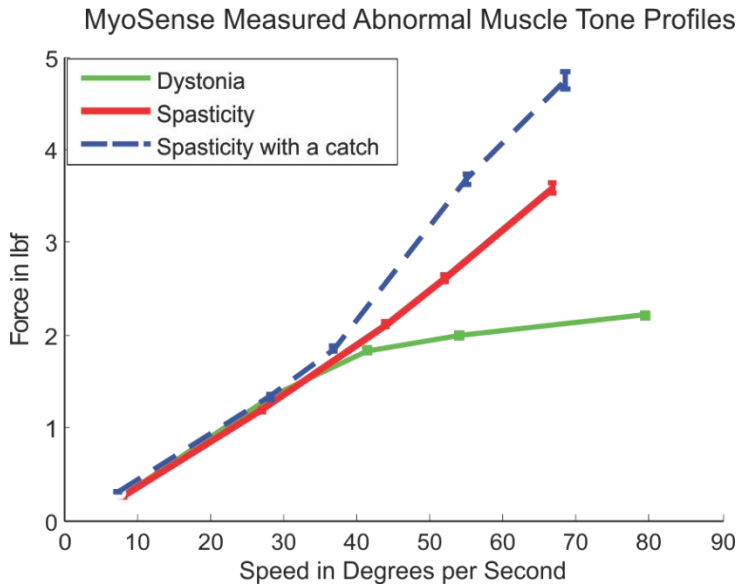
Comparing Different Abnormal Tone Profiles

- Correlation of 0.99
- Distinguish Profiles and Changes in magnitude





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Bench Testing Conclusion

- Successful pilot evaluation of MyoSense
- Clinical evaluation with individuals with spasticity, dystonia, and cerebral palsy

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MyoSense Clinical Evaluation

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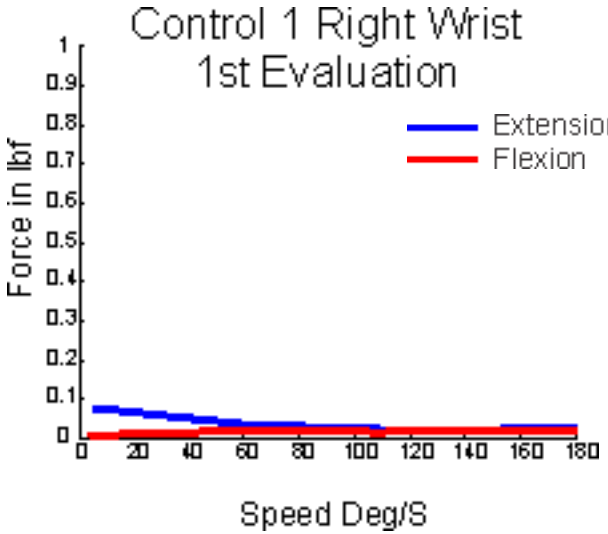
Clinical Evaluation Protocol

- Subjects
  - 10 Pure dystonia
  - 10 Pure spasticity
  - 10 Mixed dystonia and spasticity (Cerebral Palsy)
  - 30 Age matched controls

- Clinician manipulates limb
  - 5, 45, 90, 135, 180
  - wrist, elbow, knee, ankle
  - Mod Ashworth and Fahn Marsden Burke

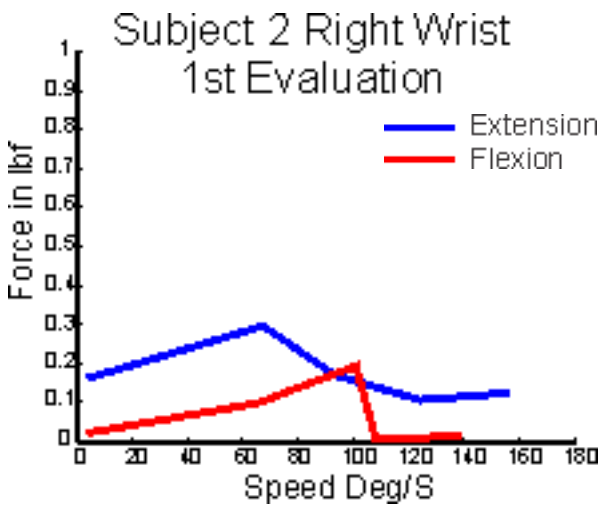
Preliminary Results

Unimpaired Control

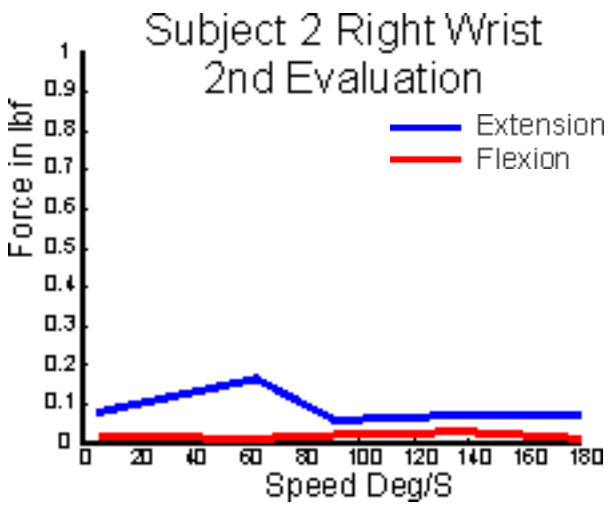


Individual with Dystonia

FMB = 1



FMB = 0



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Clinical Evaluation Goals

- Goal from Clinical Evaluation
  - Differentiate types of abnormal muscle tone
  - Examine correlation to clinical measures

- Commercialization
  - Effects of spasticity and dystonia
  - Effects of treatments

Acknowledgements

- Dr. Erwin Montgomery
- Dr. Ilia Itin
- Alexandria Wyant

- Funding from NIH

National Institute of Neurological Disorders and Stroke (1R43NS076052-01A1)

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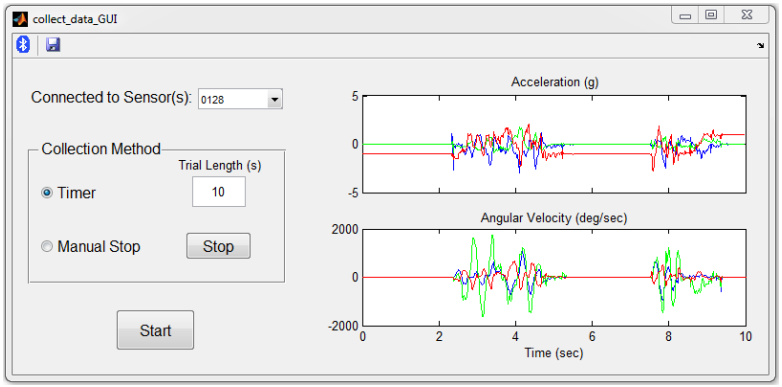
GLNT Movement Sensor



http://glneurotech.com/motion-sensor

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Questions?

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