My 5 Year (or 10 Year) Research Plan at the University of Nebraska Omaha

(How I will/won’t get tenure....)

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Rehab Research Meeting: 5-29-2015
Recruiting Graduate Students!
PROJECT: Gait Rehabilitation and Movement Variability

Loss of ‘Complexity’ of Movement Variability with Pathology....

‘Healthy Variability’

Loss of ‘Complexity’

(overly constrained, overly random)
PROJECT: Gait Rehabilitation and Movement Variability

*Interventions to Regain ‘Healthy’ Variability*...
No passive (unpowered) prosthesis to date has normalized the metabolic cost of walking in transtibial amputees...
PROJECT: Unpowered Prostheses to Normalize Gait

But in theory, no ‘power’ is needed for steady-state walking....

Ankle + Foot = (~87% Energy Return)
PROJECT: Unpowered Prostheses to Normalize Gait

A Prescription Model to Customize Ankle-Foot Prostheses

‘Spring-Loaded Roll-Over’ Model (from healthy ankle-foot)

Subject-Specific Customization (based on height, weight, speed)
For every step, the foot dissipates ~16 Joules of energy....
For every step, the foot dissipates ~16 Joules of energy.

Energy into Heat?

1.0 Deg C after 200 steps of walking [Wrobel et al., 2014]
Diabetic Foot:

Skin temperature as early sign of ulcer formation

[Brand 2004]
The foot as a ‘transmission’ to control the gear-ratio....

Plantar flexor muscles acting against an external load

[Robertson and Sawicki, 2014]
PROJECT: (Basic Science) Foot & Ankle Biomechanics

*Modulating muscle capacity with footwear....*

- Low Stiffness (Low Gear)
- Low Force, High Velocity
- High Stiffness (High Gear)
- High Force, Low Velocity
PROPOSAL:
Walking with Diabetic Feet: Mechanics, Energetics & Thermodynamics