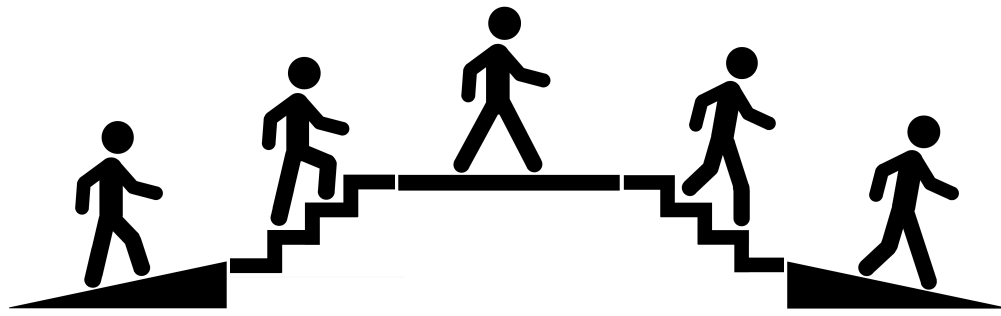


Effects of Prosthetic Forefoot Stiffness on Ankle and Knee Mechanics on Level Ground, Ramps and Stairs

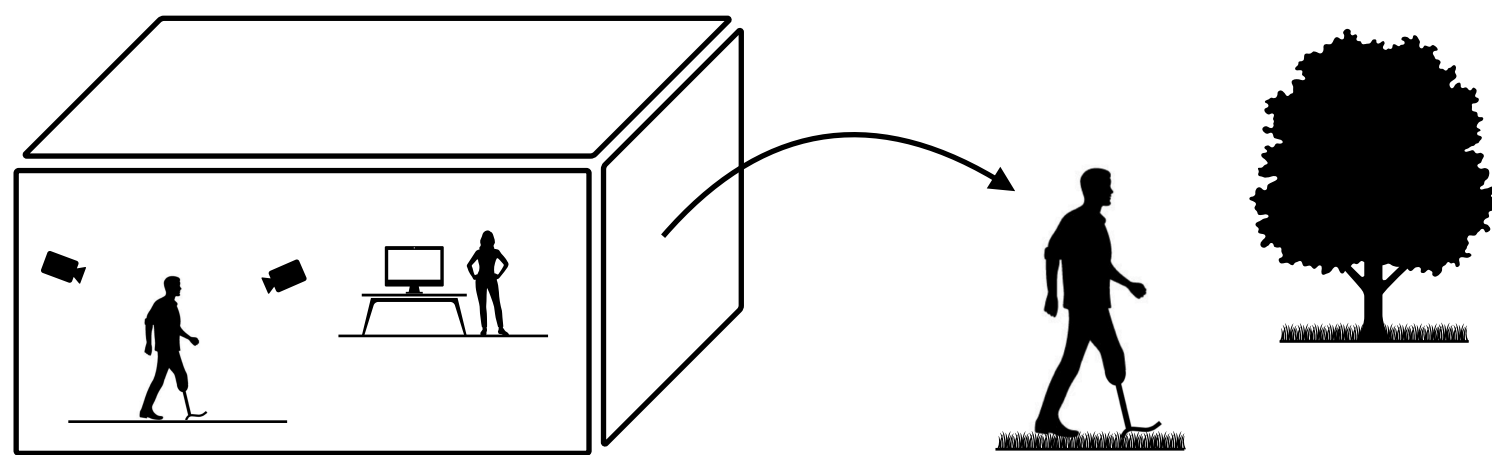
Katherine Heidi Fehr, Jennifer Leestma, and Peter G. Adamczyk, Ph.D.

Motivation

How does forefoot stiffness affect gait on level ground, ramp & stairs?

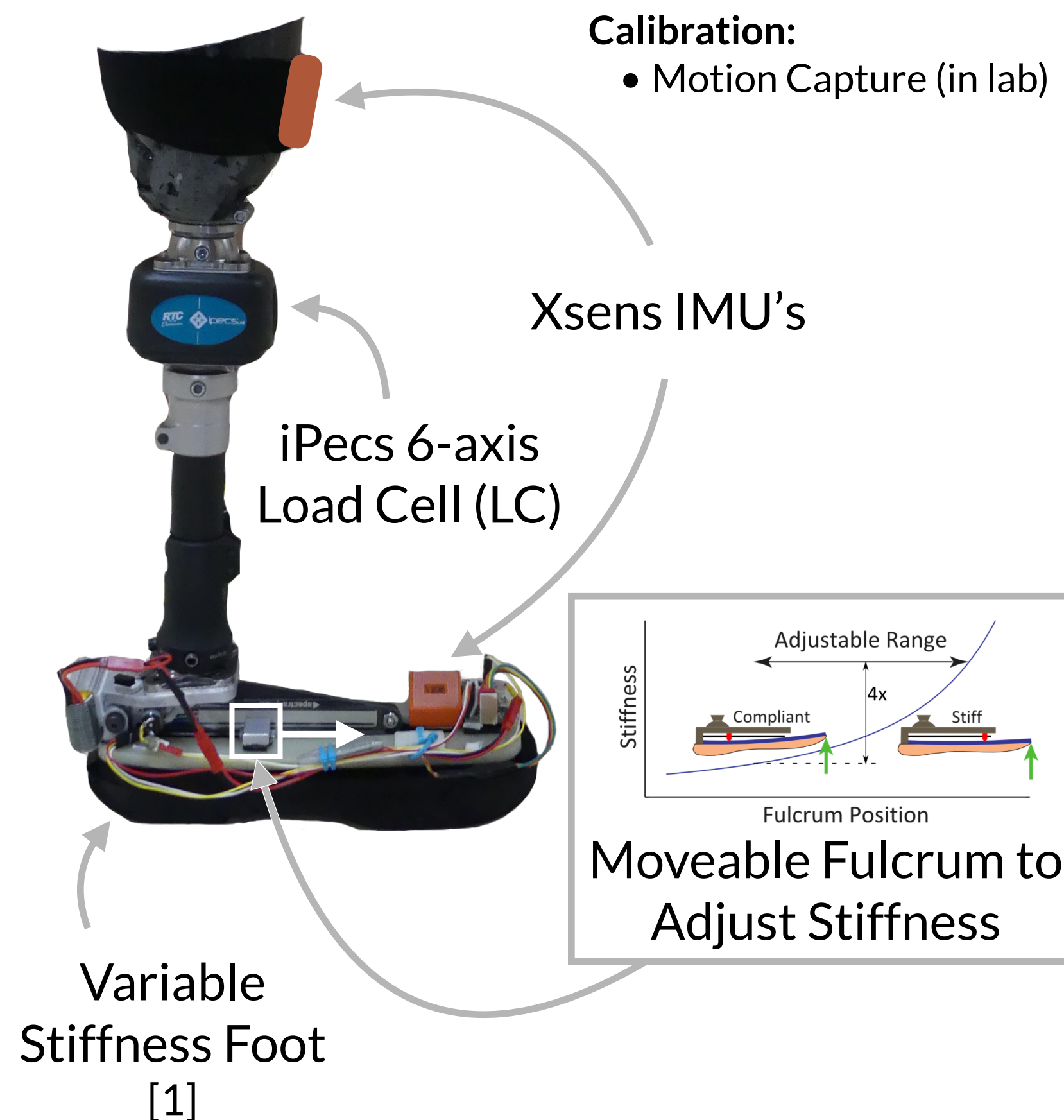


Conduct study using wearable sensors.



Can DMAMA reflect biomechanical changes caused by stiffness?

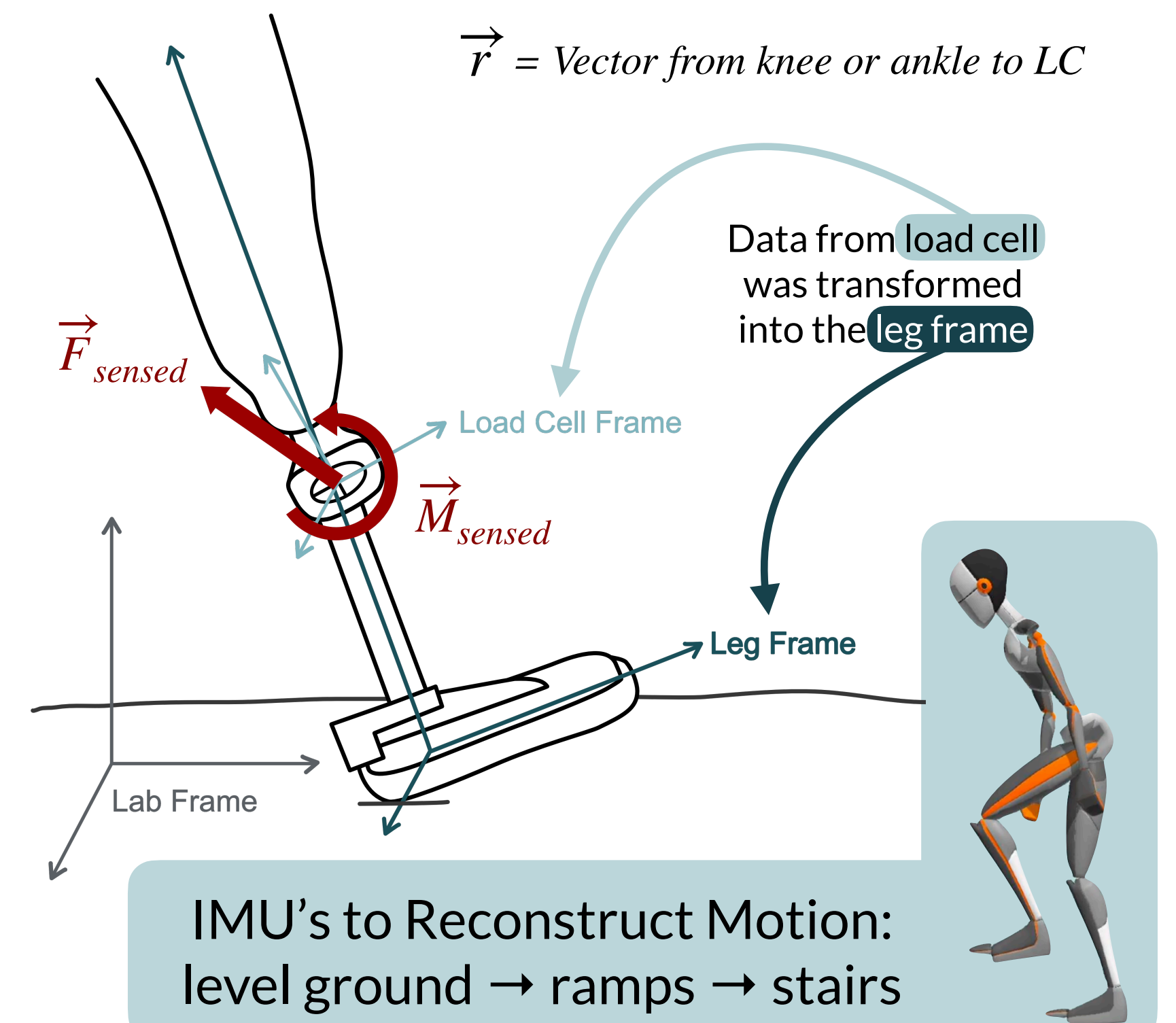
Hardware



Data Processing

$$\text{Knee/Ankle Moment} = \vec{r} \times \vec{F}_{sensed} + \vec{M}_{sensed}$$

\vec{r} = Vector from knee or ankle to LC

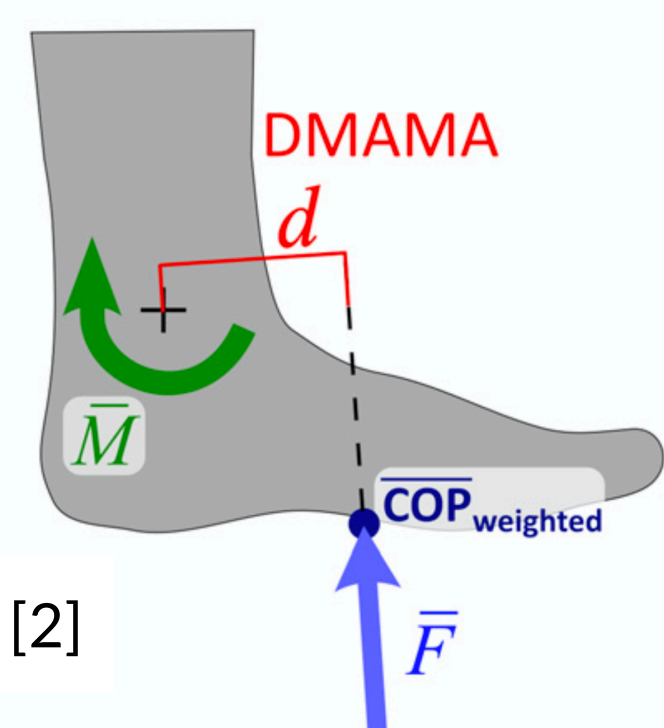


DMAMA

(Dynamic Mean Ankle Moment Arm)

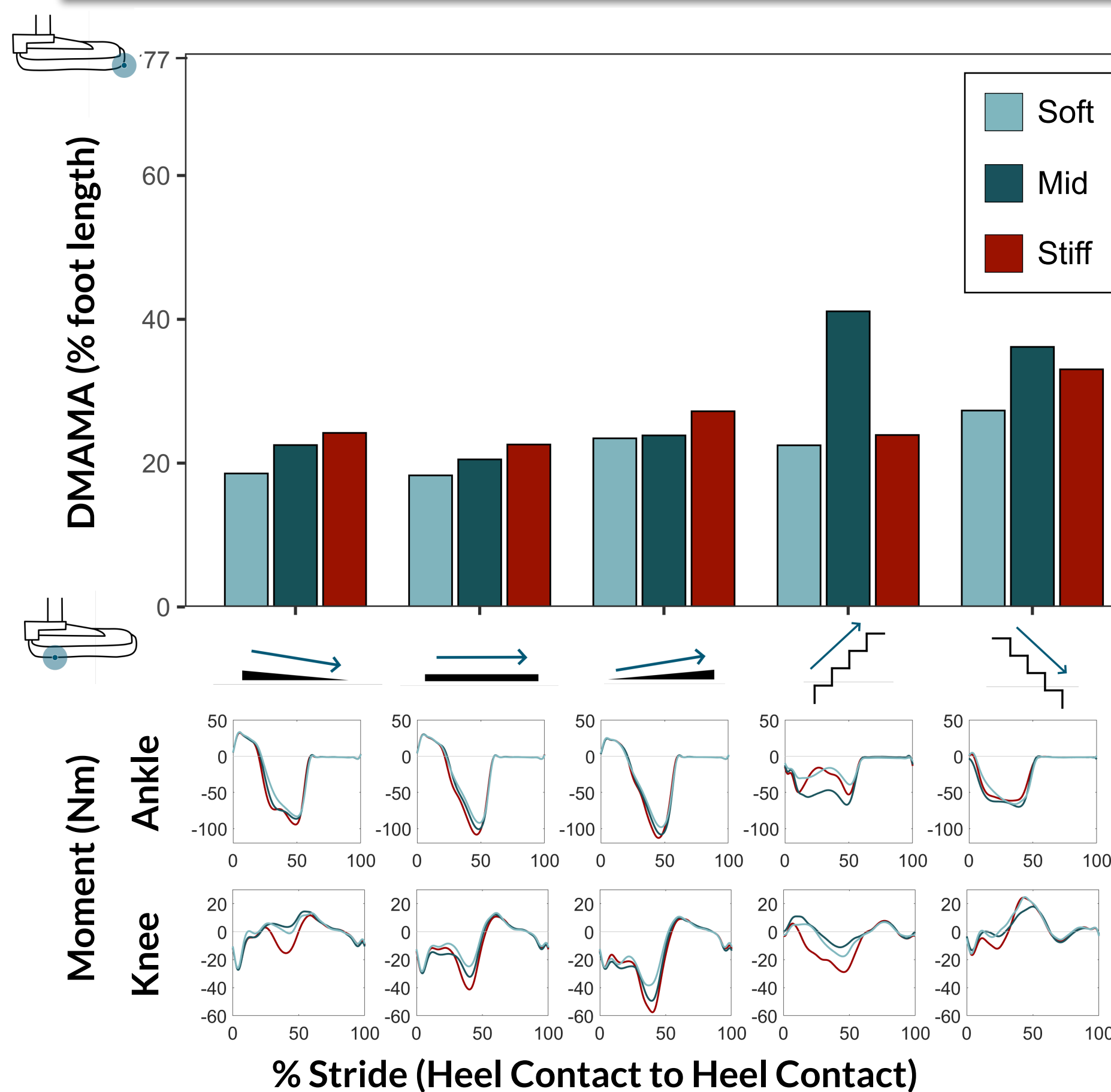
How the ankle **controls** the **location** of force interaction.

$$DMAMA: d = \frac{J}{I} = \frac{\int_{HS}^{TO} M dt}{\left| \int_{HS}^{TO} \vec{F} dt \right|} = \frac{\bar{M}}{\bar{F}}$$



Single number to summarize stance phase.

Results & Discussion



Level & Ramps

Higher Stiffness:
 • Greater DMAMA
 • Greater Knee Moment

Stairs

Highly variable

Future Work

- "Real-World" Studies
- Different Prostheses
 - Other Terrains
 - Speed [2]
 - Running [2]