Kinematic and Kinetic Analysis of a Transtibial Biarticular Prosthesis

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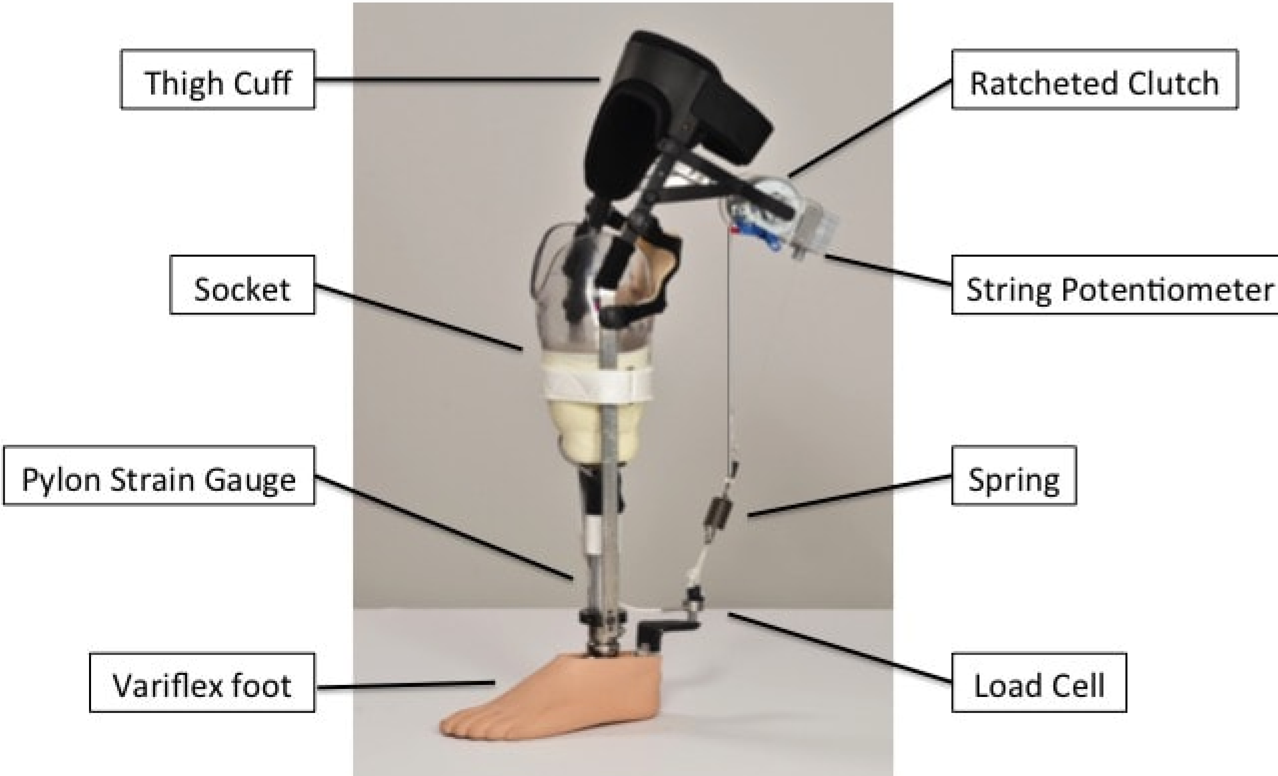
BP Prototype

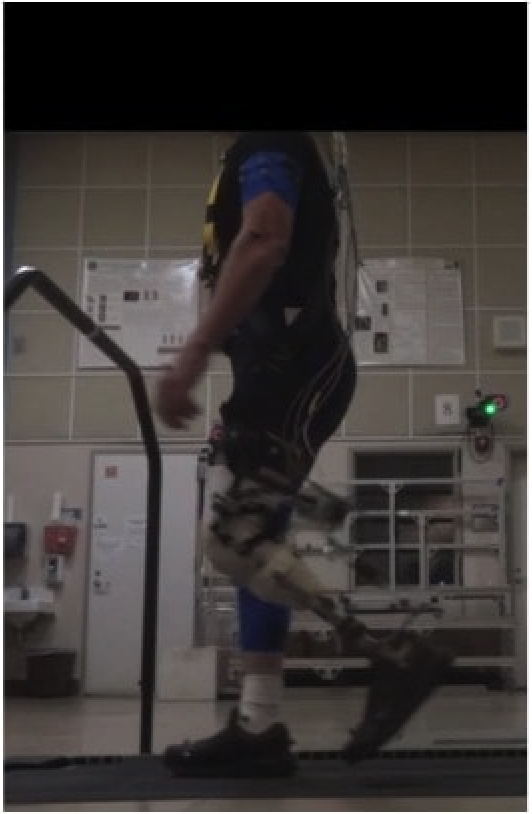


Specific Aims

1. Validate OpenSim methodology

2. Analyze how the BP affects one amputee's gait

Methods



Walking trials:

1. Prescribed Prosthesis
2. BP with increasing spring stiffness
   - 1.85 N/mm
   - 3.7 N/mm
   - 10 N/mm
   - Stiff
3. Unpowered BP

Vicon

Marker trajectories

Ground reaction forces

Matlab

Processing and formatting

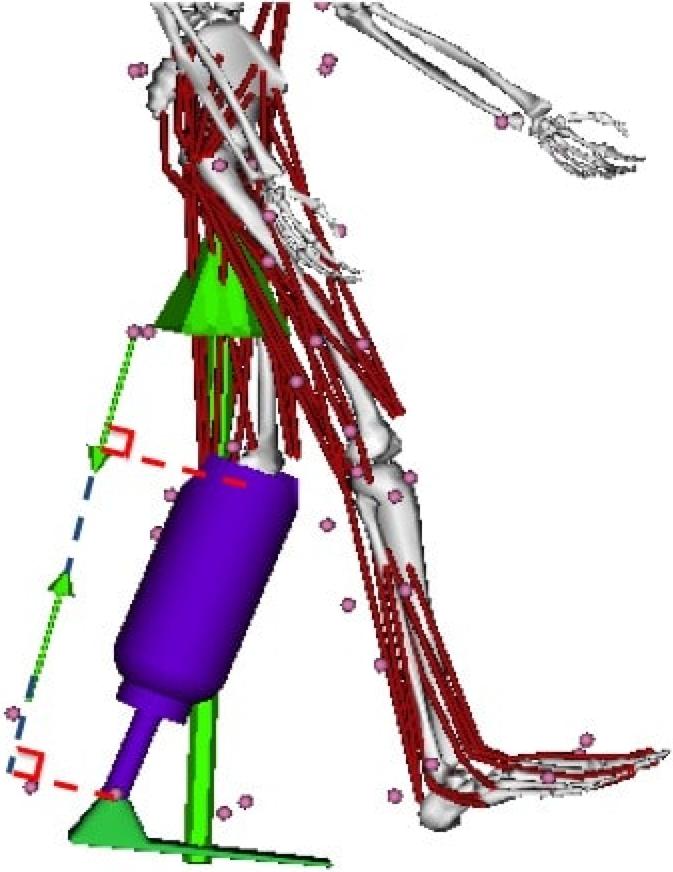
OpenSim

Scale

Inverse Kinematics

Inverse Dynamics

Matlab τ_{BP} Calculation

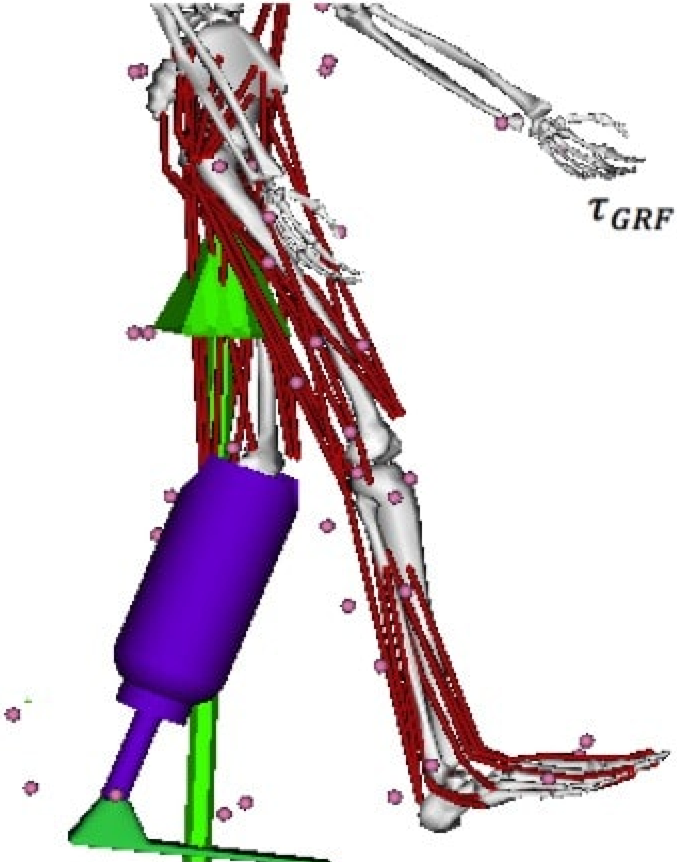


F – measured from load cell

r – Calculated in OpenSim using preset points of application

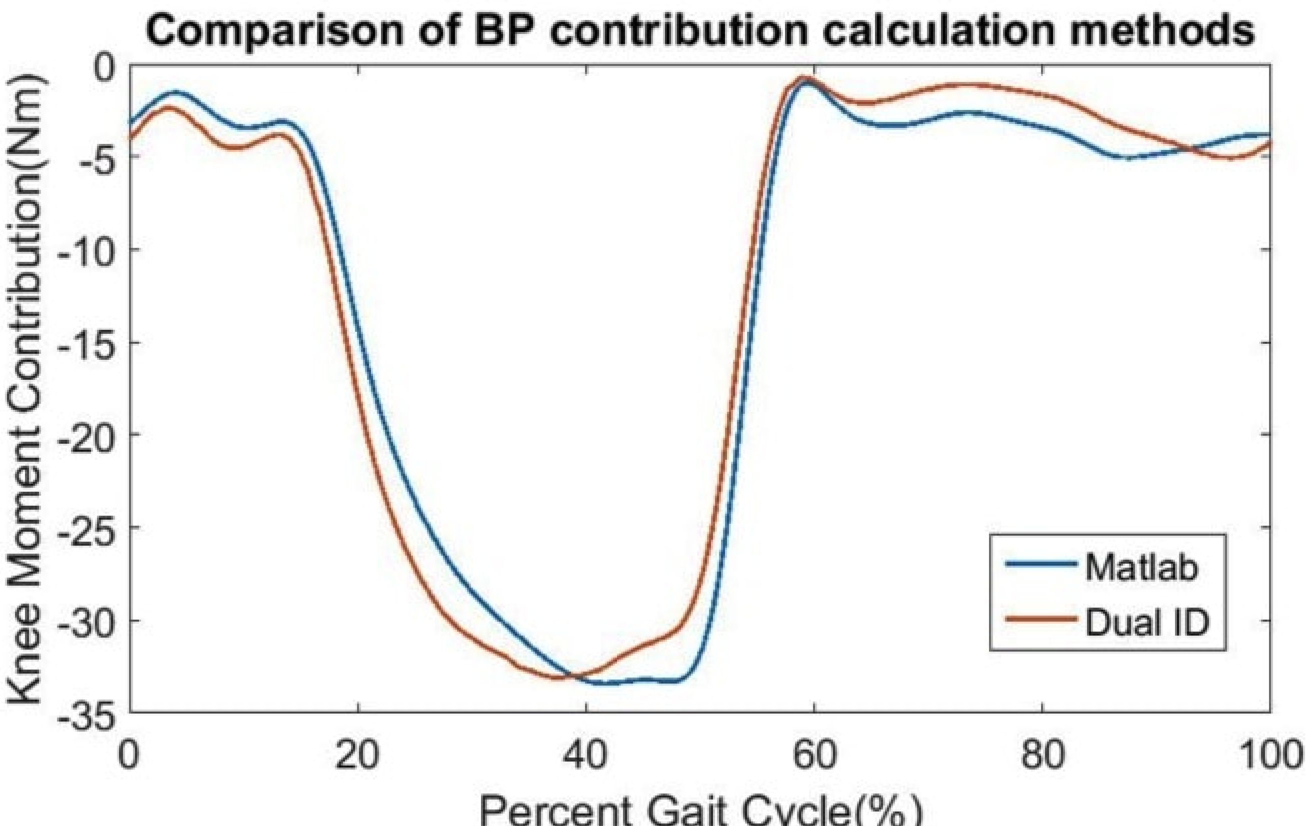
$$\tau_{BP} = \mathbf{r} \times \mathbf{F}$$

Dual Inverse Dynamics

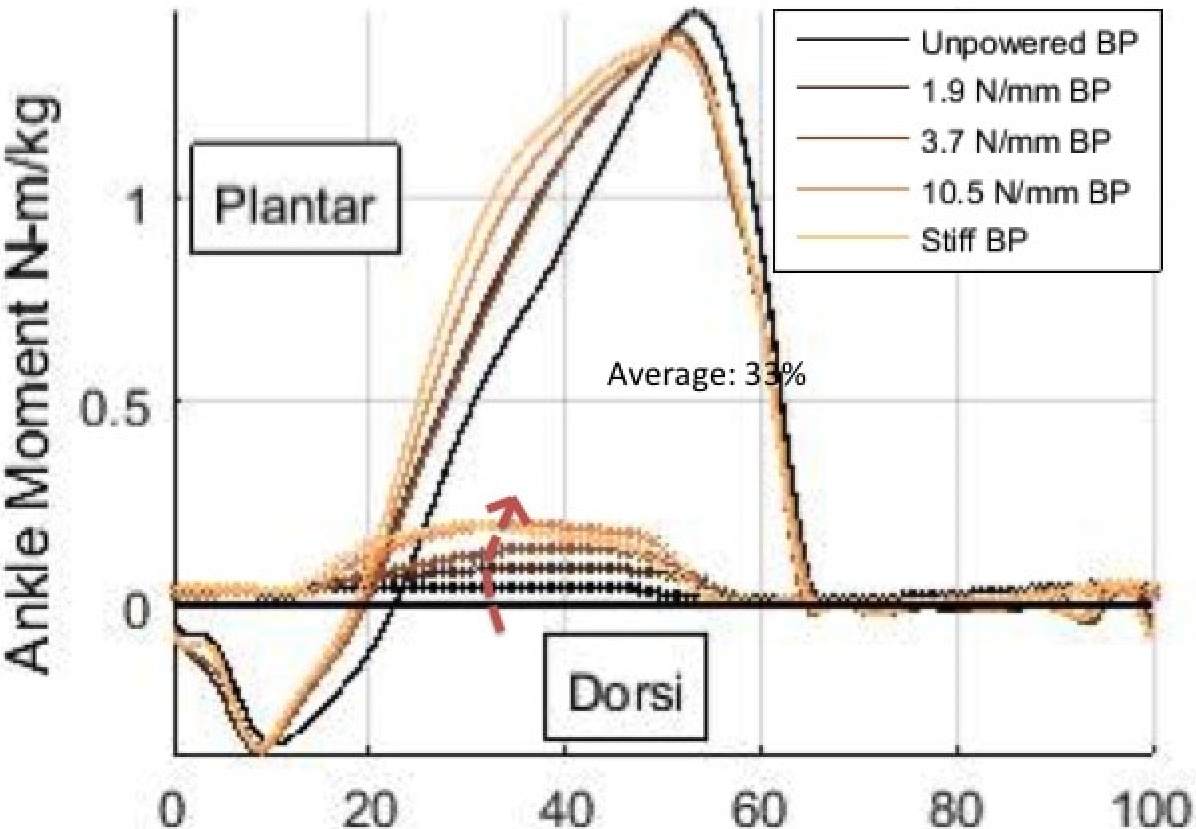


$$\tau_{GRF} + \tau_{other} + \tau_{unknown} = I\alpha$$

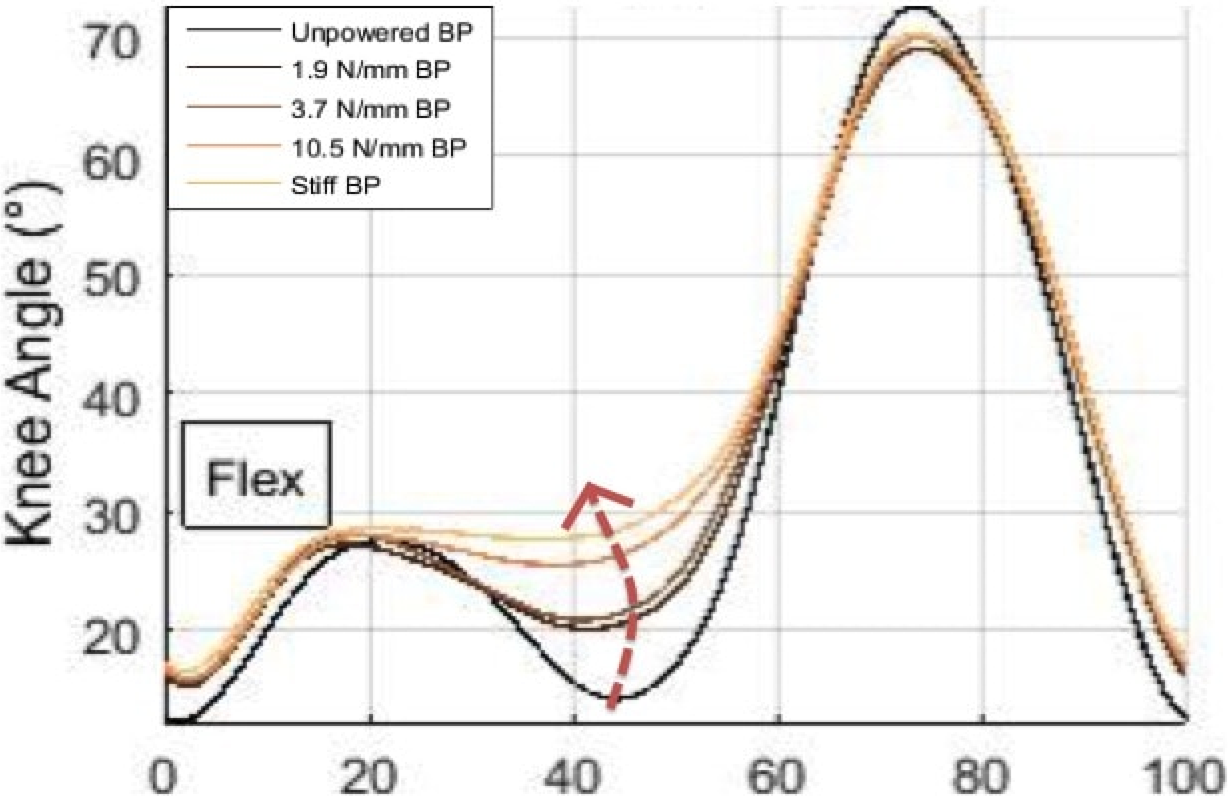
Methods Comparison



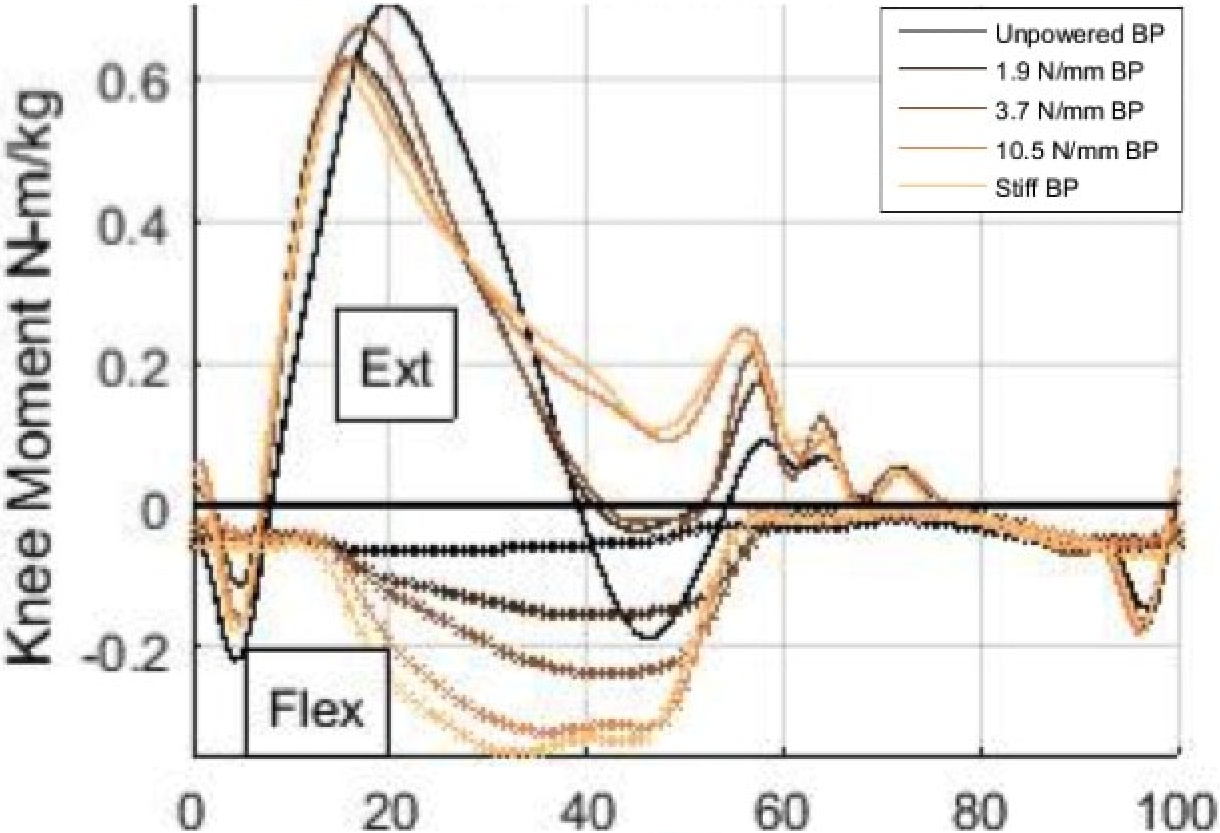
BP Ankle Contribution



Knee Kinematics



BP Knee Contribution



Discussion

- Dual ID method is an accurate and valid method to compute the BP contribution to joint torques
- BP contribution to ankle plantar flexion torque increased as stiffness increased
- More analysis and additional subjects needed to delineate the BP effects at the knee

Acknowledgments

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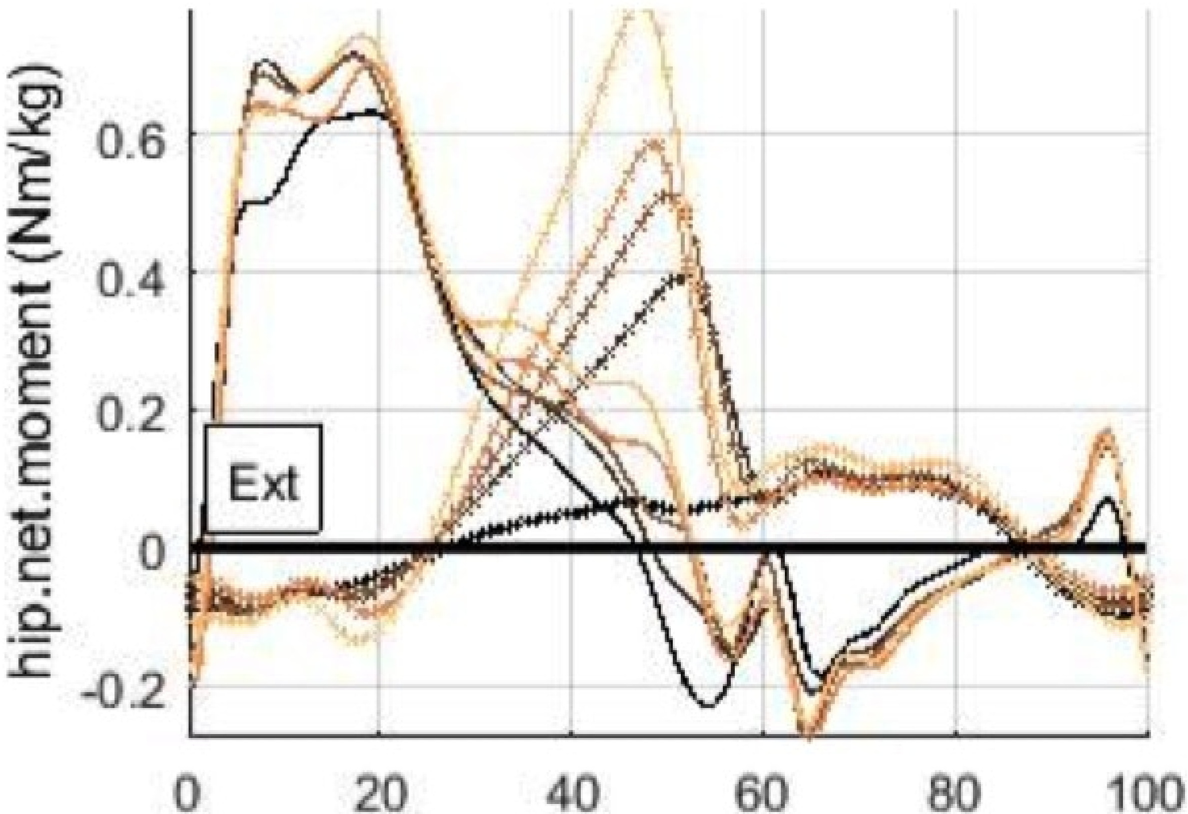
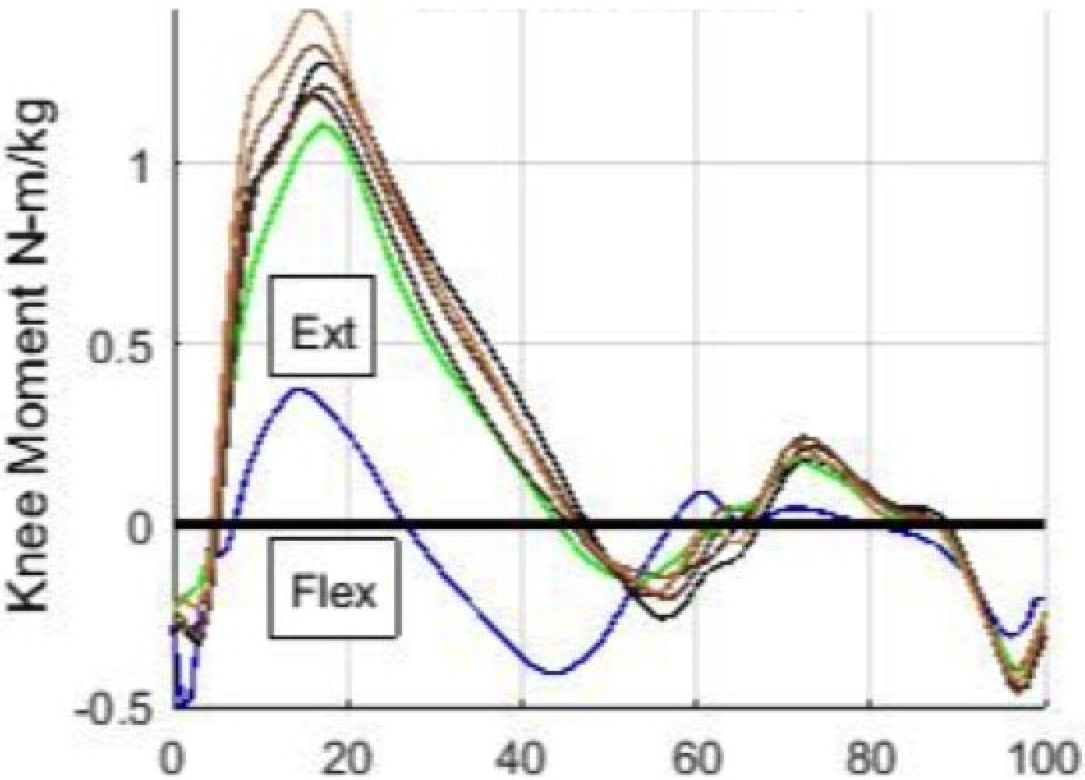
Hip Moment



Contralateral Knee Moment



Ipsilateral Knee Moment