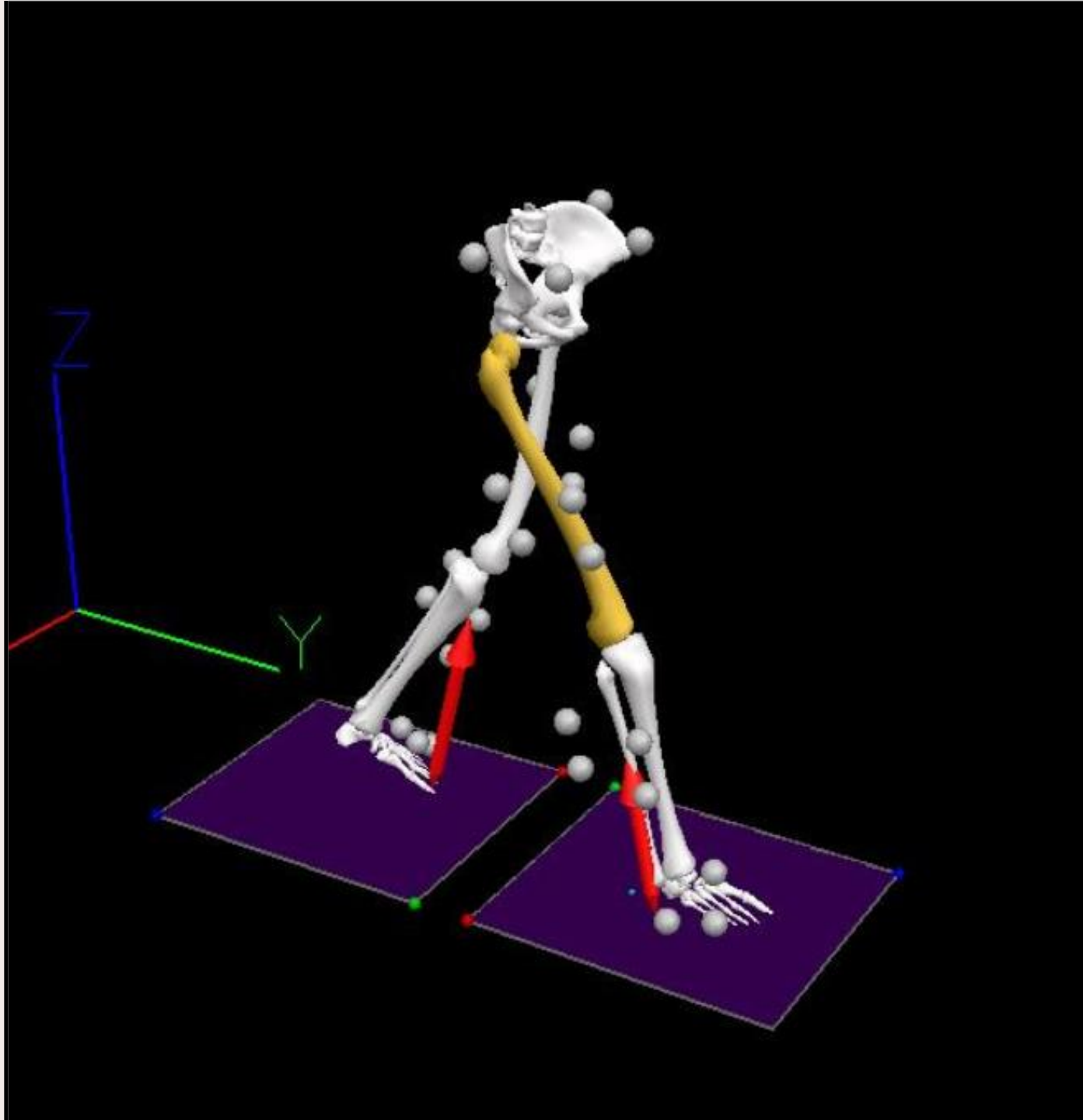
Walking vs Running Case Study

ADVANCED BIOMECHANICAL RESEARCH AND INNOVATION CHALLENGES

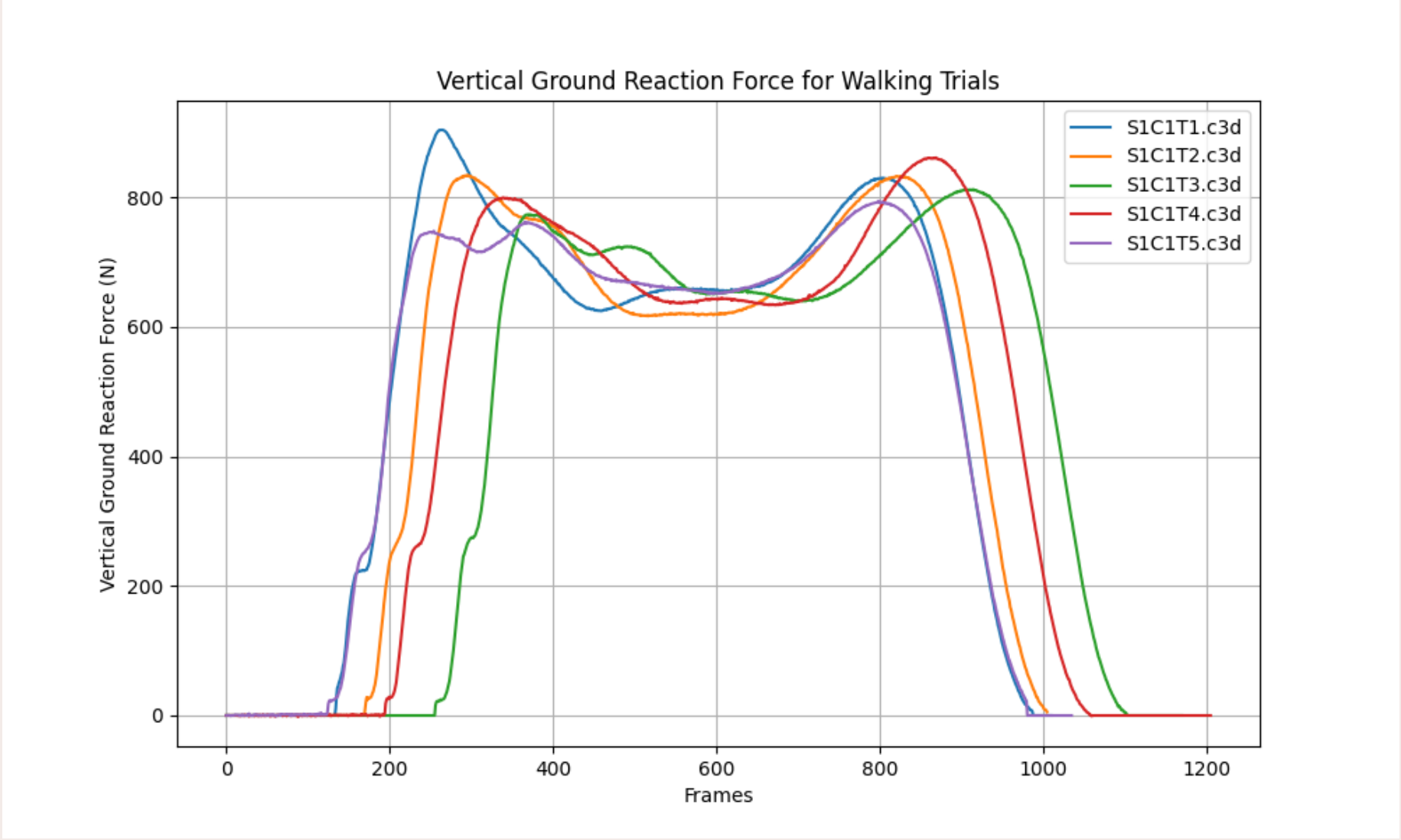
Terms

BIOMECHANICS - The applications of mechanics to biological system (hamill and knutzen 1995)

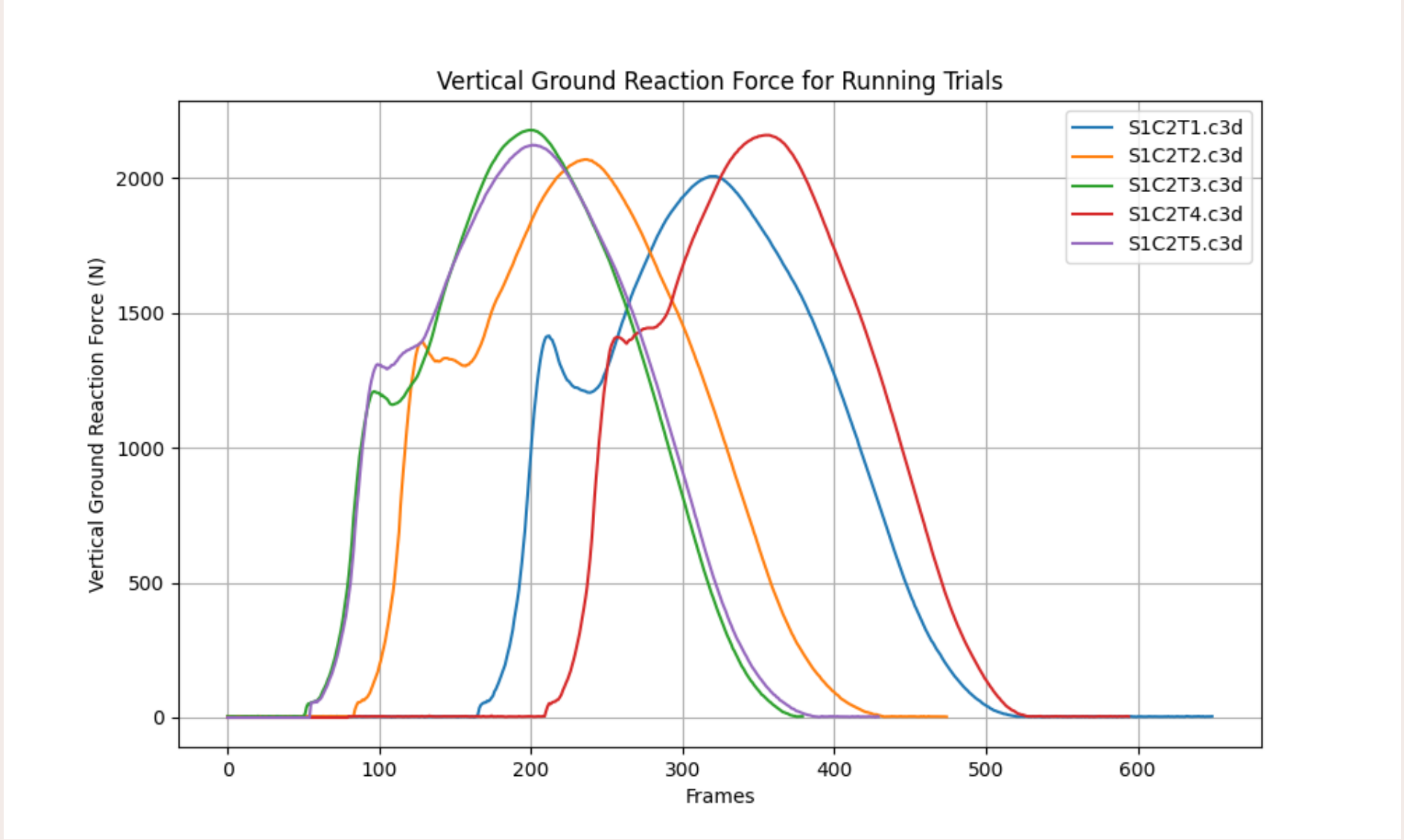
The science that examines forces acting upon and within a biological structure and effects produced by such forces (NIGG 1995)



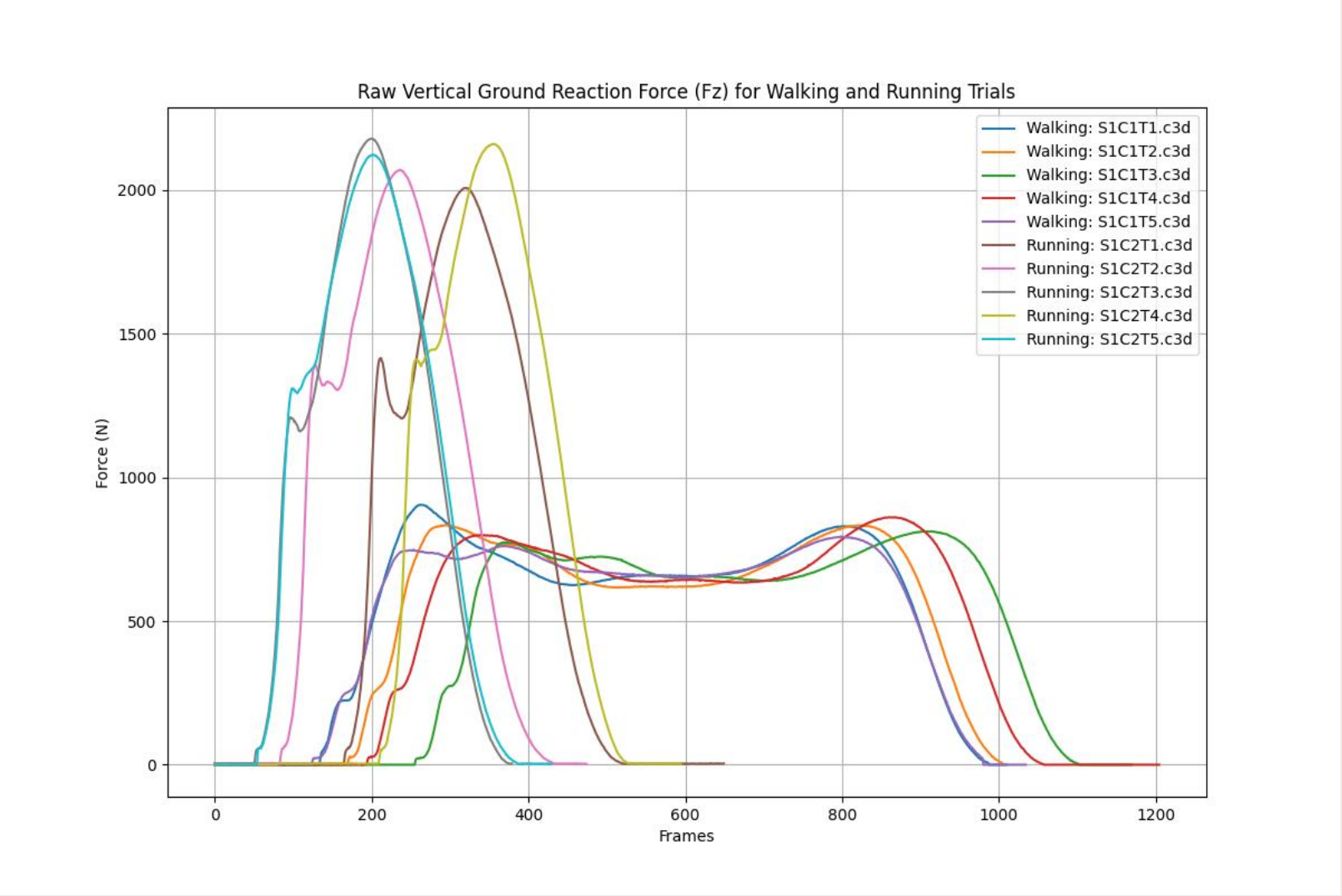
Walking Curve



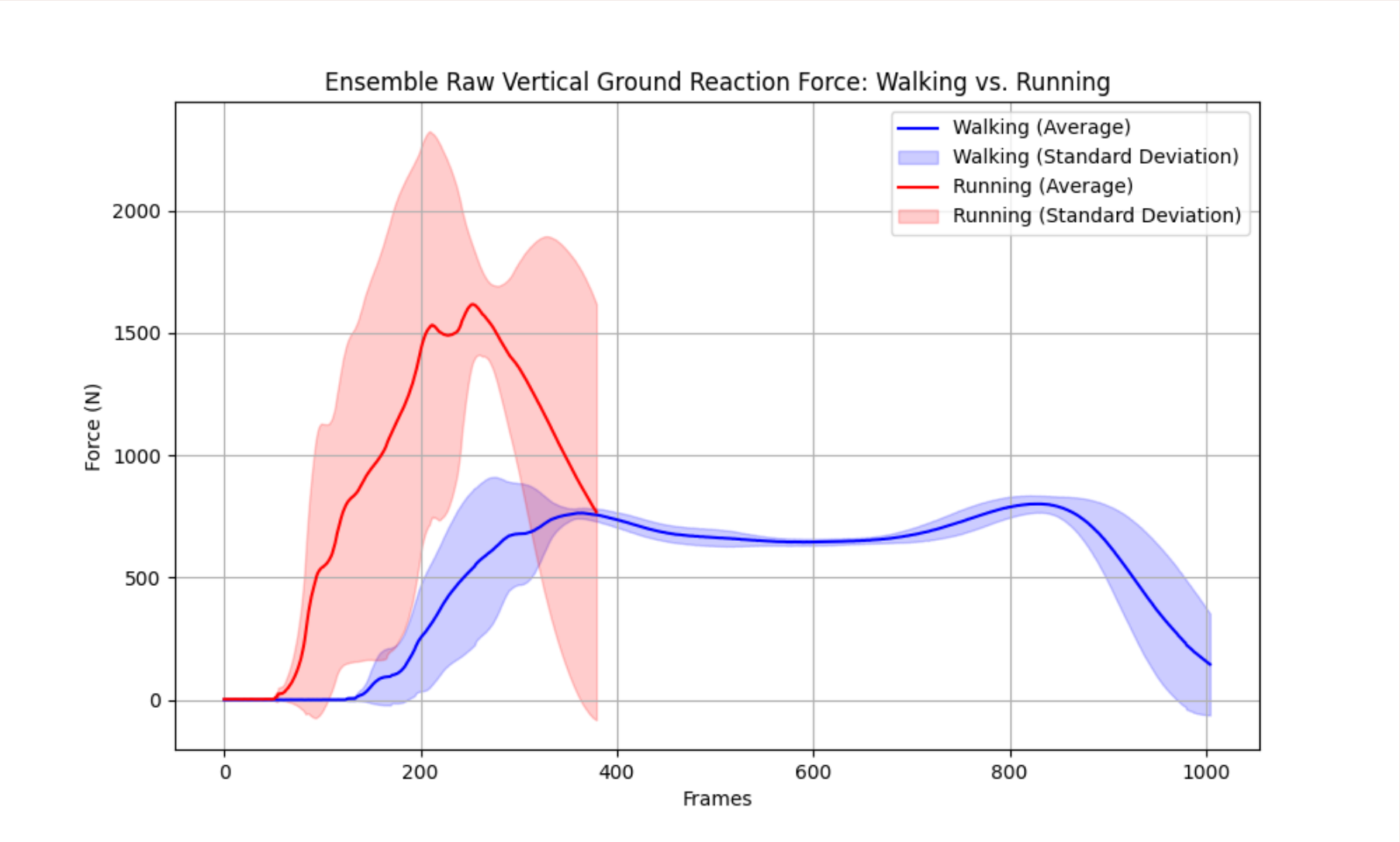
Running Curves



Combined

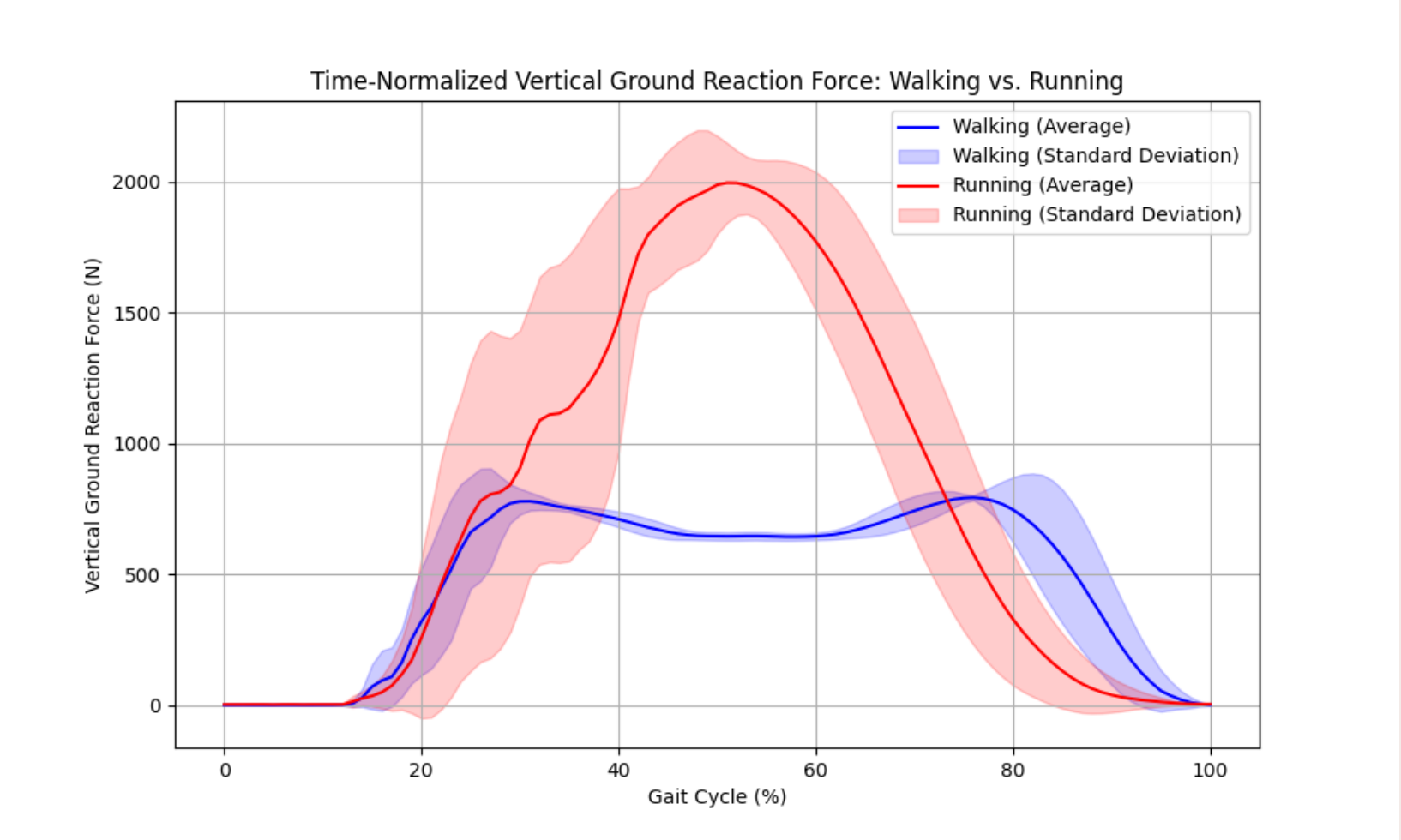

Raw Vertical Ground Reaction Force (Fz) for Walking and Running Trials
Walking: S1C1T1.c3d
Walking: S1C1T2.c3d
Walking: S1C1T3.c3d
Walking: S1C1T4.c3d
Walking: S1C1T5.c3d
Running: S1C2T1.c3d
Running: S1C2T2.c3d
Running: S1C2T3.c3d
Running: S1C2T4.c3d
Running: S1C2T5.c3d
Force (N)
0
500
1000
1500
2000
0
200
400
600
800
1000
1200
Frames

Combined Means



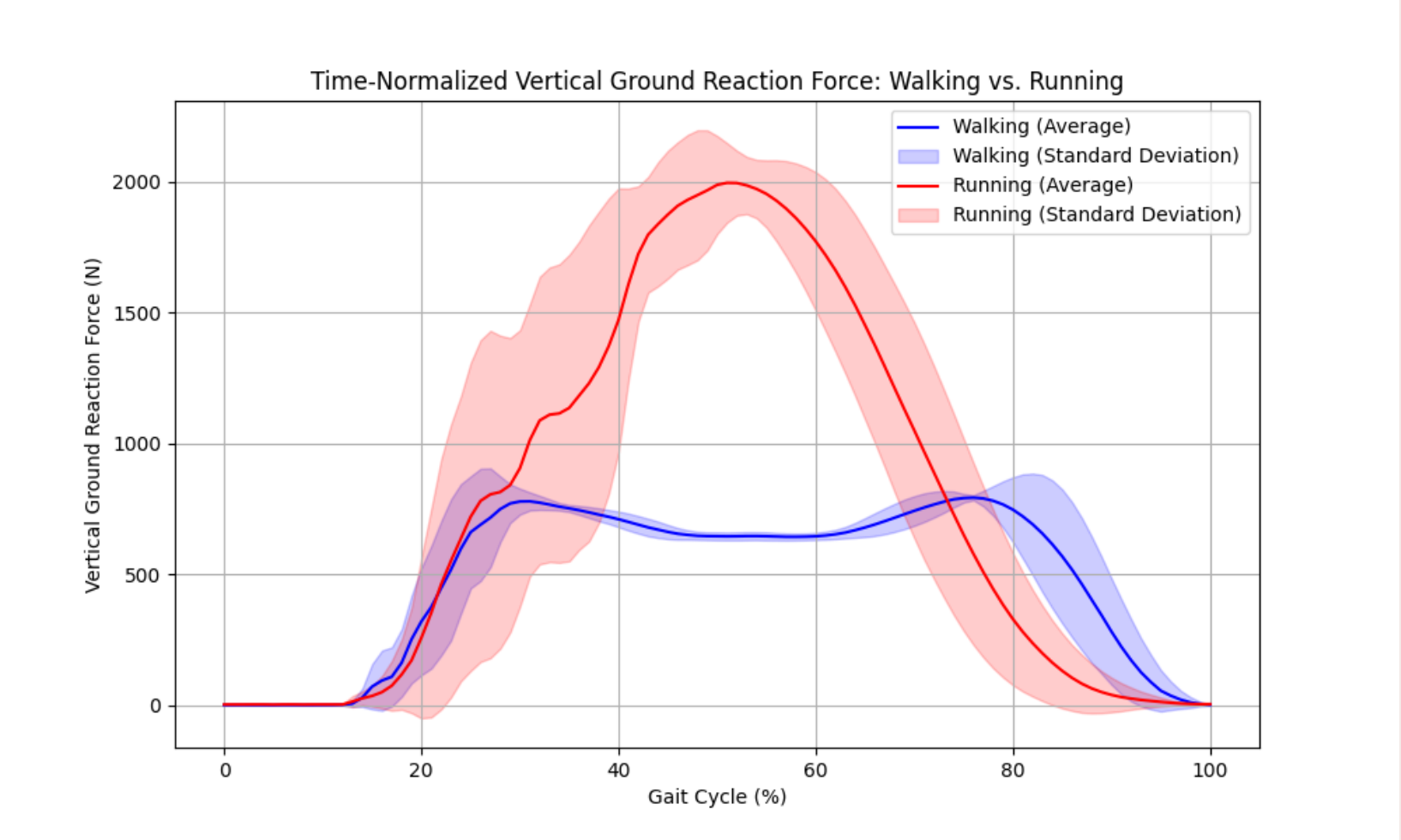
Standardized

- Completed so we have 101 frames



Standardized

- Completed so we have 101 frames

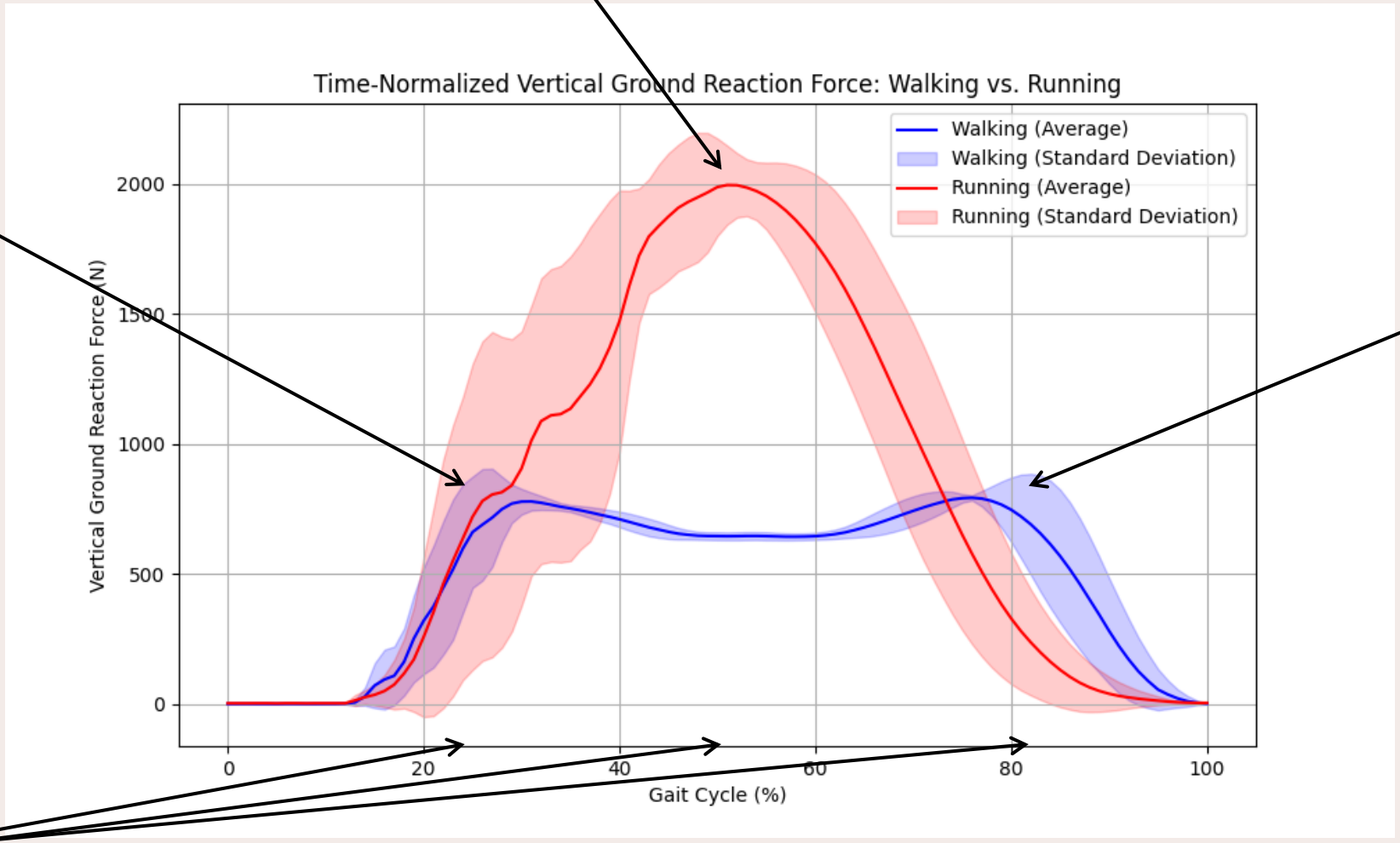


Traditionally

Global Peak

First Peak

2nd Peak



Time to Peak

Statistical Parametric Mapping

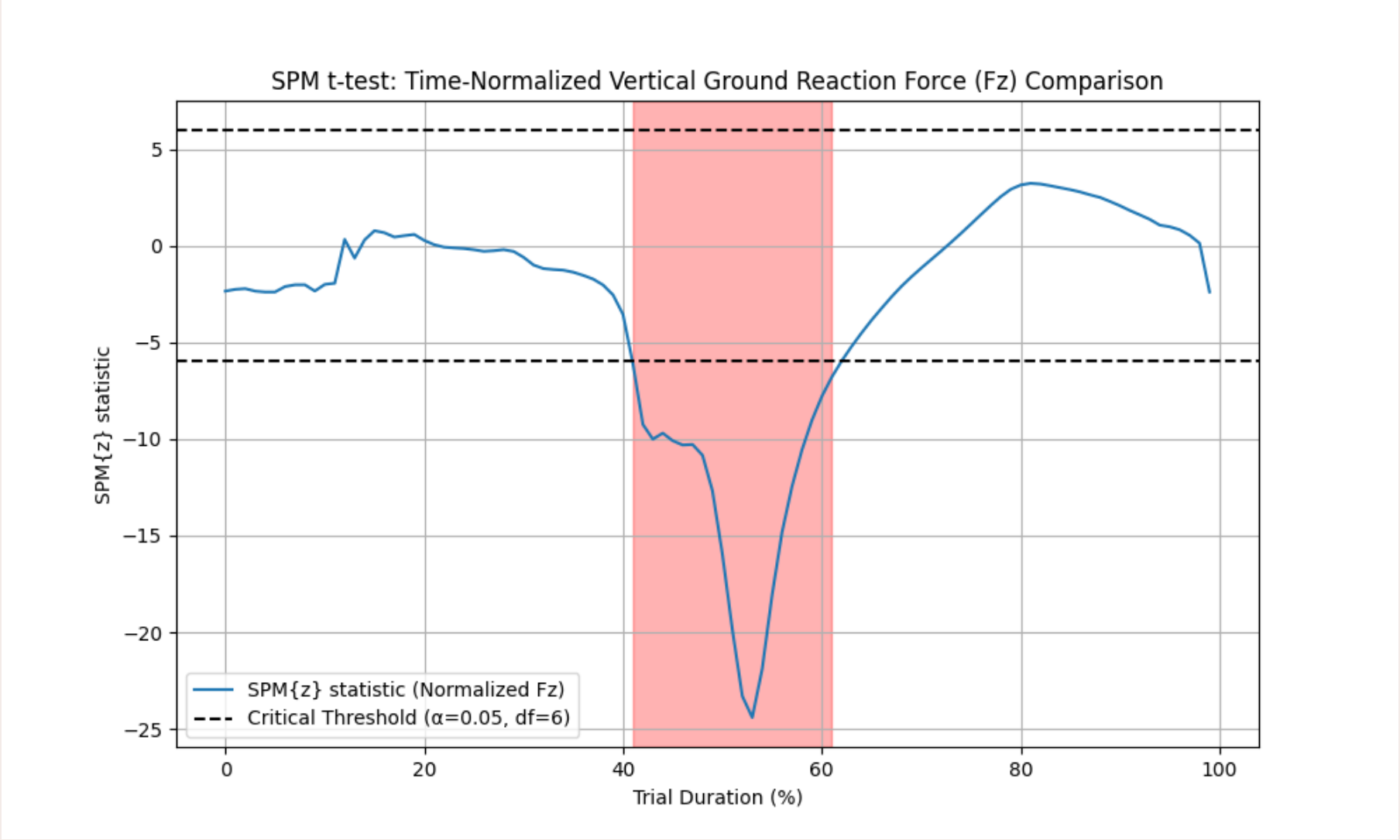
What is it?

- SPM allows you to compare the entire time-series curve between groups
  - Performs statistical tests at each data point along the time axis
- Examining the specific time intervals that are highlighted and the sign of the SPM
- Gain insights into *when* and *how* the vertical ground reaction force differs
- Two groups might have similar peak forces but different loading rates or durations of force application, which SPM can detect

Main Take away

- SPM allows you to explore differences across the entire curve without having to make these a priori assumptions about where differences might occur.

Example


SPM t-test: Time-Normalized Vertical Ground Reaction Force (Fz) Comparison
SPM{z} statistic
Trial Duration (%)
5
0
−5
−10
−15
−20
−25
0
20
40
60
80
100
SPM{z} statistic (Normalized Fz)
Critical Threshold (α=0.05, df=6)