Reaching a Competition Ready Back Handspring
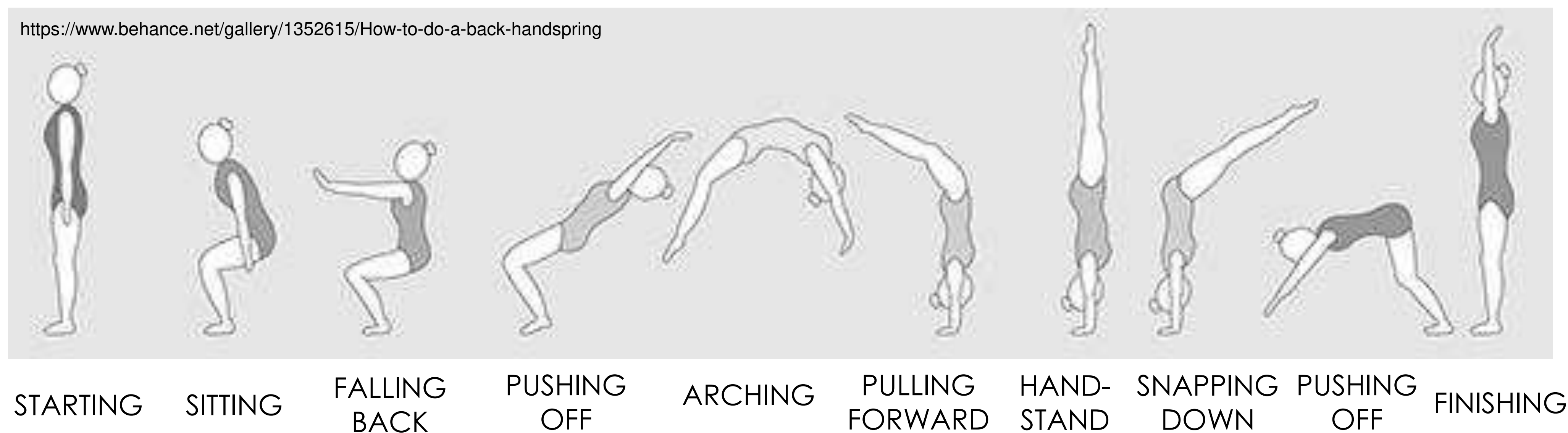
Cyndia Cao

2.671 Instrumentation and Measurement

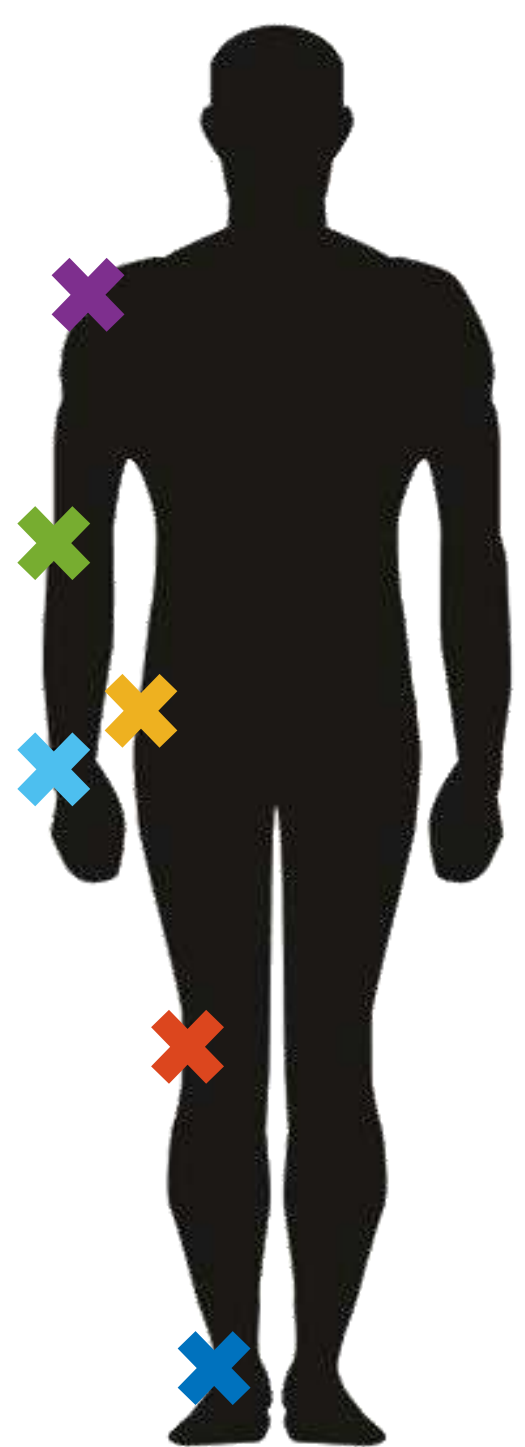**Massachusetts Institute of Technology**

Abstract

MIT Cheerleading's biggest challenge in competition is a lack of tumbling. Tumblers learn back handsprings, a fundamental skill, from standing on a spring floor but compete from a round-off (running) on a mat floor. Video was taken at 240 Hz to characterize changes in the back handspring based on entry method and floor type. While most changes were minor, standing and running back handsprings showed large differences in momentum change. This suggests that new tumblers should learn the motion from standing but focus on achieving the running back handspring first because it is significantly less demanding on the arms.
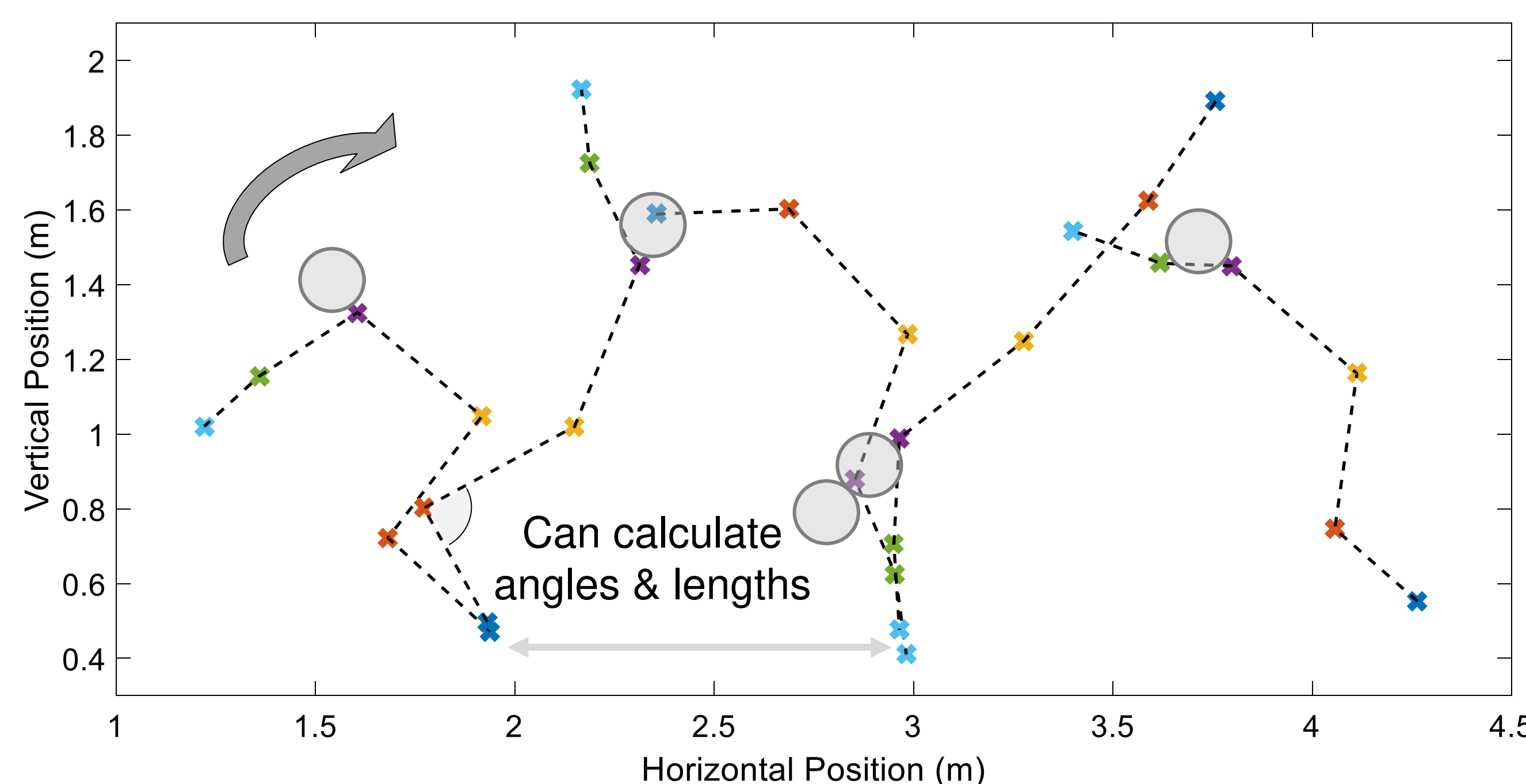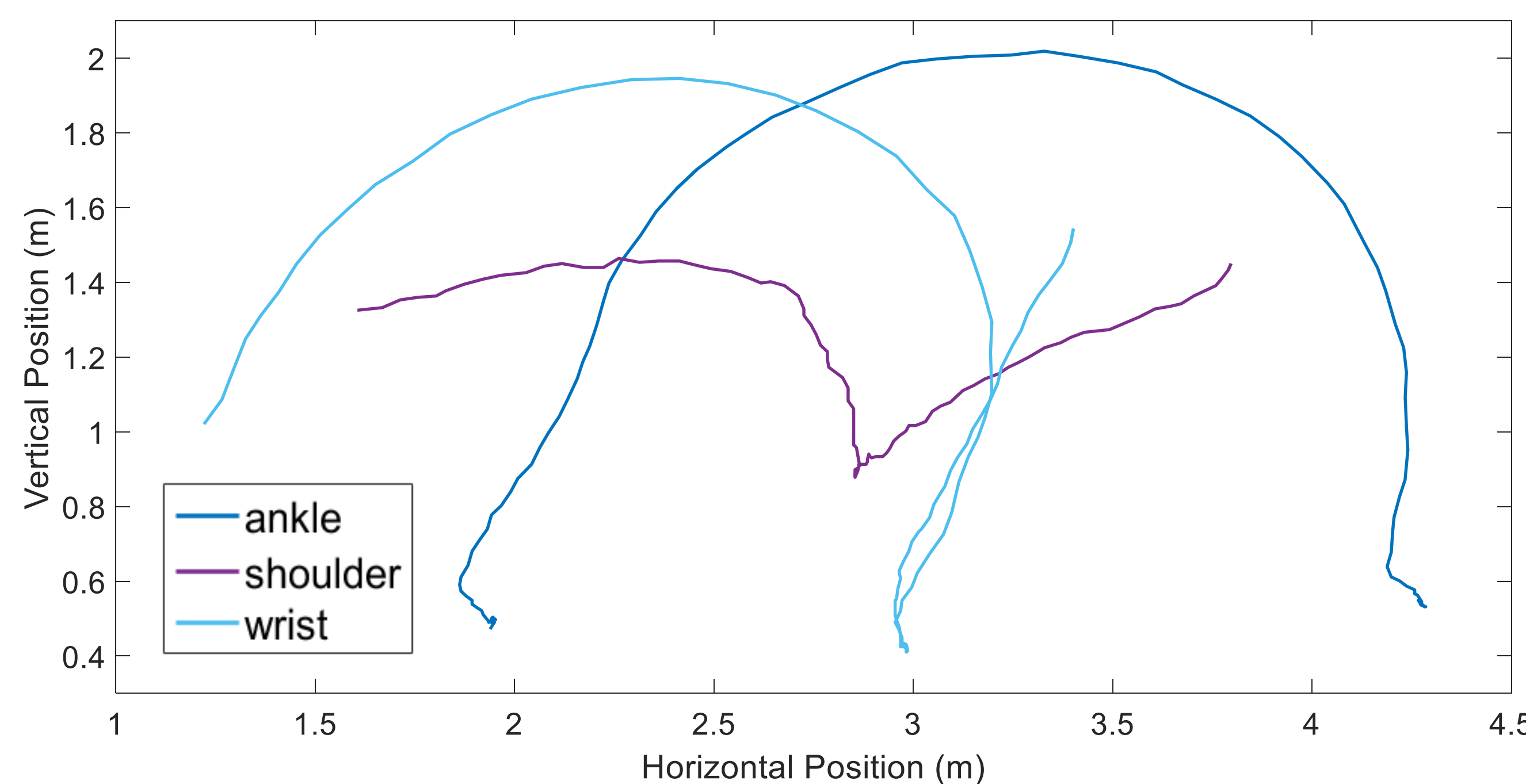
Motion of a Back Handspring

https://www.behance.net/gallery/1352615/How-to-do-a-back-handspring

STARTING   SITTING   FALLING BACK   PUSHING OFF   ARCHING   PULLING FORWARD   HAND-STAND   SNAPPING DOWN   PUSHING OFF   FINISHING

Data Acquisition

Video at 240 Hz
6 trials each scenario

Human Silhouette from
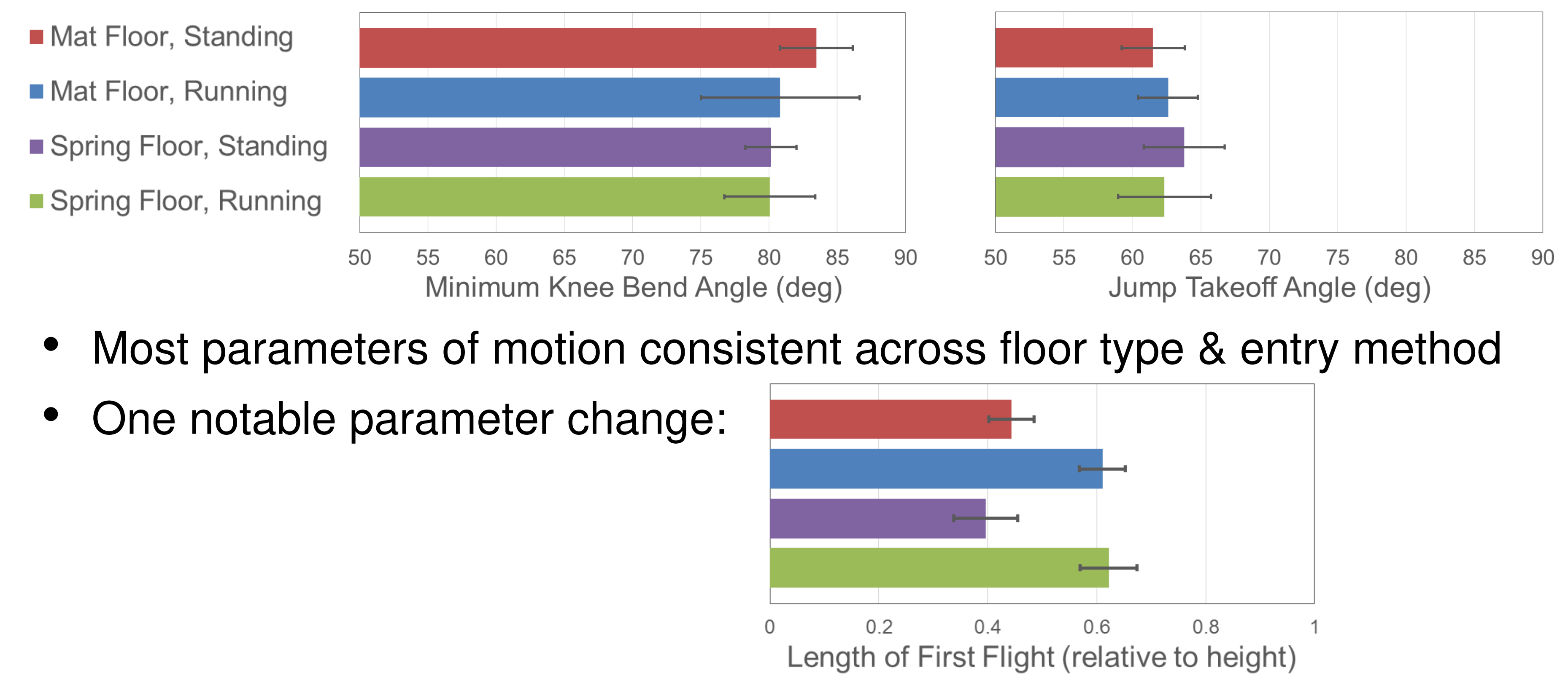http://www.freevectors.net/files/large/
FreeVectorHumanSilhouette.jpg

Key motion parameters:
- Min. knee angle (start of jump)
- Back projection of hip from ankle (at min. knee angle)
- Jump takeoff angle
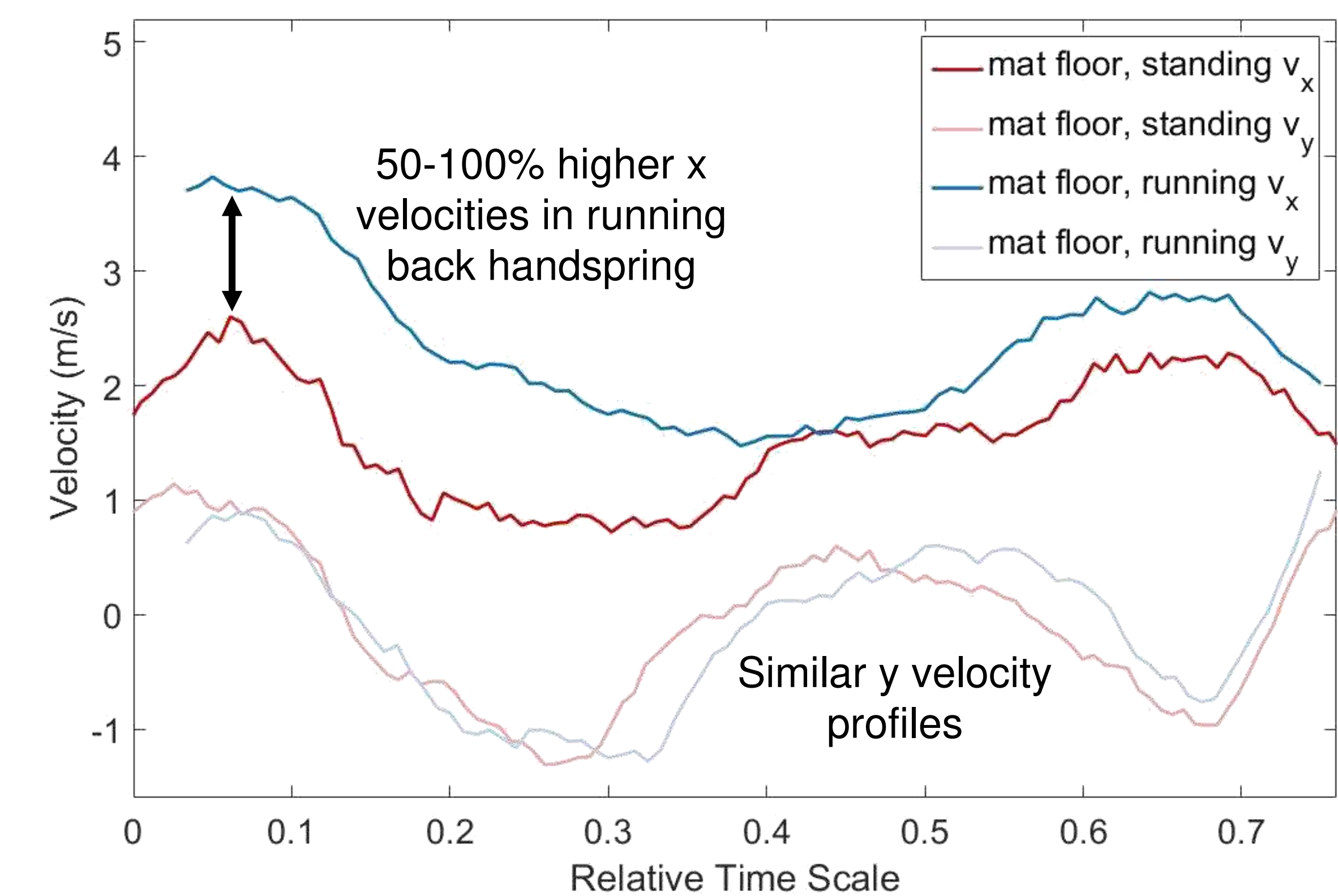- Shoulder pushing displacement
- Flight lengths

Can calculate angles & lengths

Transferable Skills

- Mat Floor, Standing
- Mat Floor, Running
- Spring Floor, Standing
- Spring Floor, Running

- Most parameters of motion consistent across floor type & entry method
- One notable parameter change:

Impact of Running Start

50-100% higher x velocities in running back handspring

Similar y velocity profiles

- mat floor, standing v_x
- mat floor, standing v_y
- mat floor, running v_x
- mat floor, running v_y

- Standing back handsprings require >2x impulse during handstand
- Elasticity of floor has little effect on momentum

- Mat Floor, Standing
- Mat Floor, Running
- Spring Floor, Standing
- Spring Floor, Running
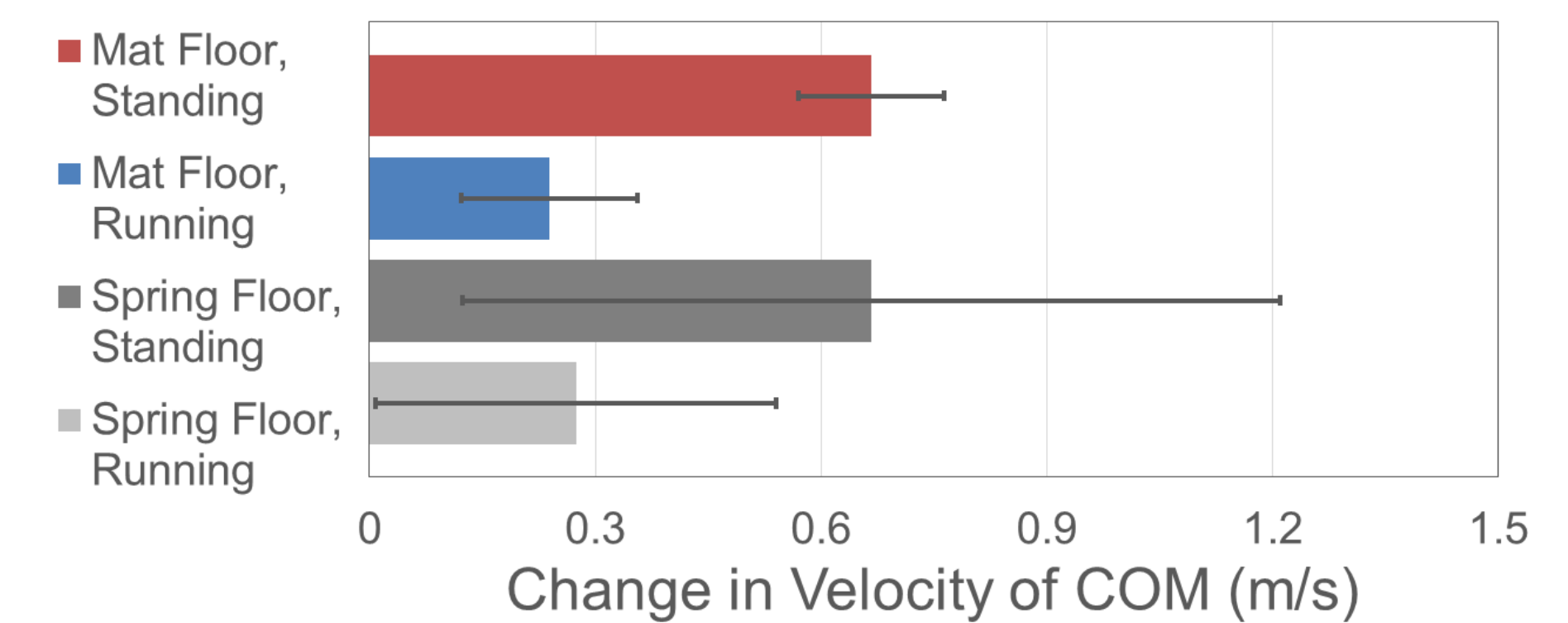
Conclusion

- Suggests that tumblers should aim for a running back handspring first because it is less demanding on the arms
- Further studies could do a closer study of the momentum changes and forces in the handstand phase to verify this

Acknowledgements

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