

Introduction

- The dynamic feasibility criterion [1,2] – that the subject's center of pressure (COP) be located within the base of support (BOS) which outlines the feet – has aided in assessing the stability of human motion recorded on earth while performing the recorded tasks in lunar gravity or countermeasures exercises on a vibration isolation and stabilization system in microgravity.
- On occasion, unphysical large-amplitude oscillatory spikes were found in the subject's linear and angular momentum derivatives, affecting analyses that depend on forces and moments derived from motion capture
- Goal: Determine and verify updates which improve model scaling, BOS estimation, inverse kinematics (IK) results, ground reaction force [3] and COP [4] results derived from motion capture data collection

Methods

Data Collection with Additional Markers

- Head – improves scaling
- Feet – improves scaling and BOS determination
- Medial elbow – determines humerus orientation

Original Model

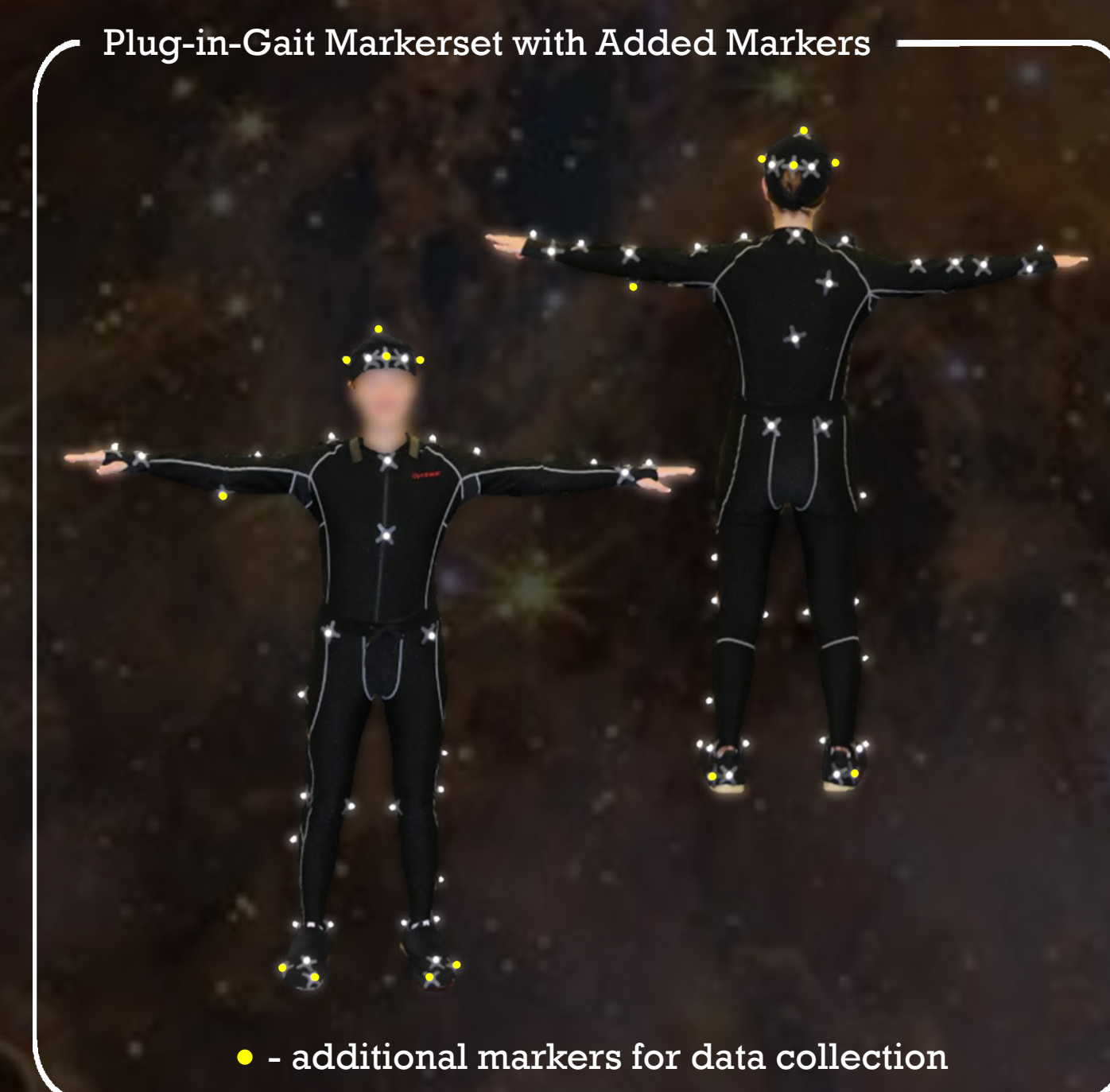
- Modified OpenSim Rajagopal Full Body Model [6, 7, 8]

Adjustments [9]

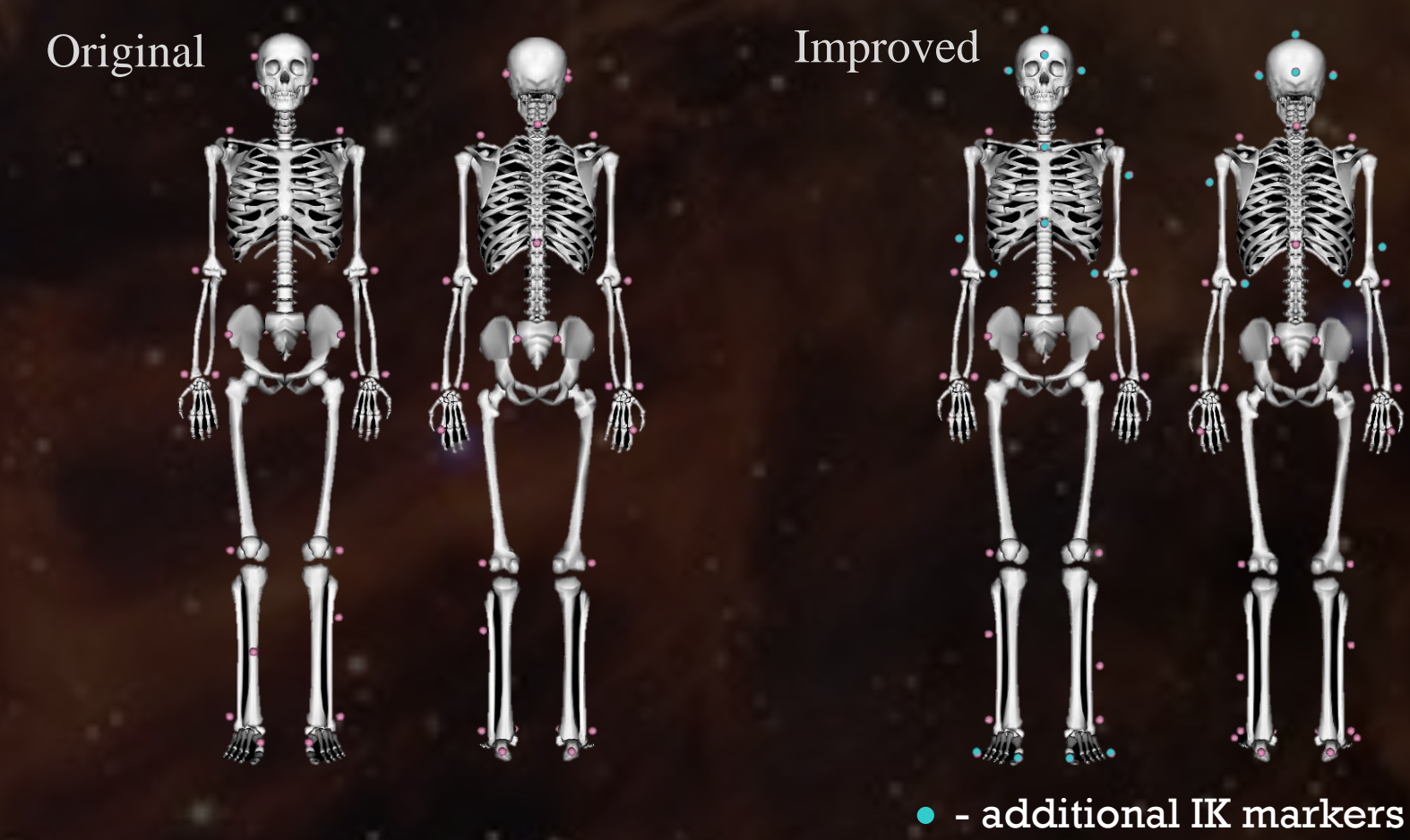
- Model
 - Shoulder Axes of Rotation
 - Pelvis Euler Angle Order
 - Rotation Limits
- Additional Markers
- Scaling
 - Additional Markers
- Constrained Inverse Kinematics
 - Additional Markers
 - Case-by-Case Markers
 - Virtual shoulder joint center markers [10]
 - Upper arm markers

Assess Results

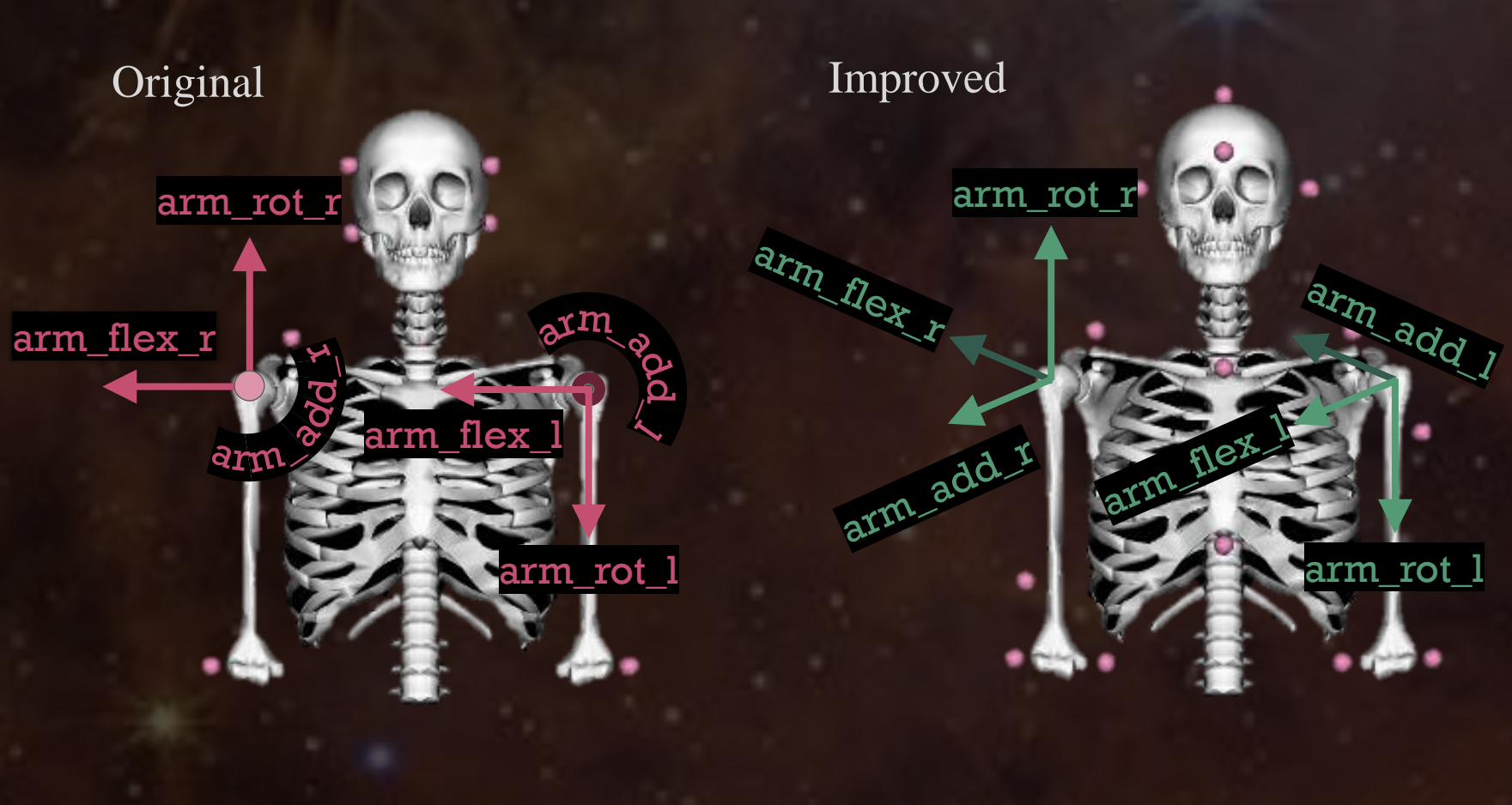
- Minimize marker error during IK
- Reasonable joint angle rates of change
- Eliminate spikes in ground reaction forces



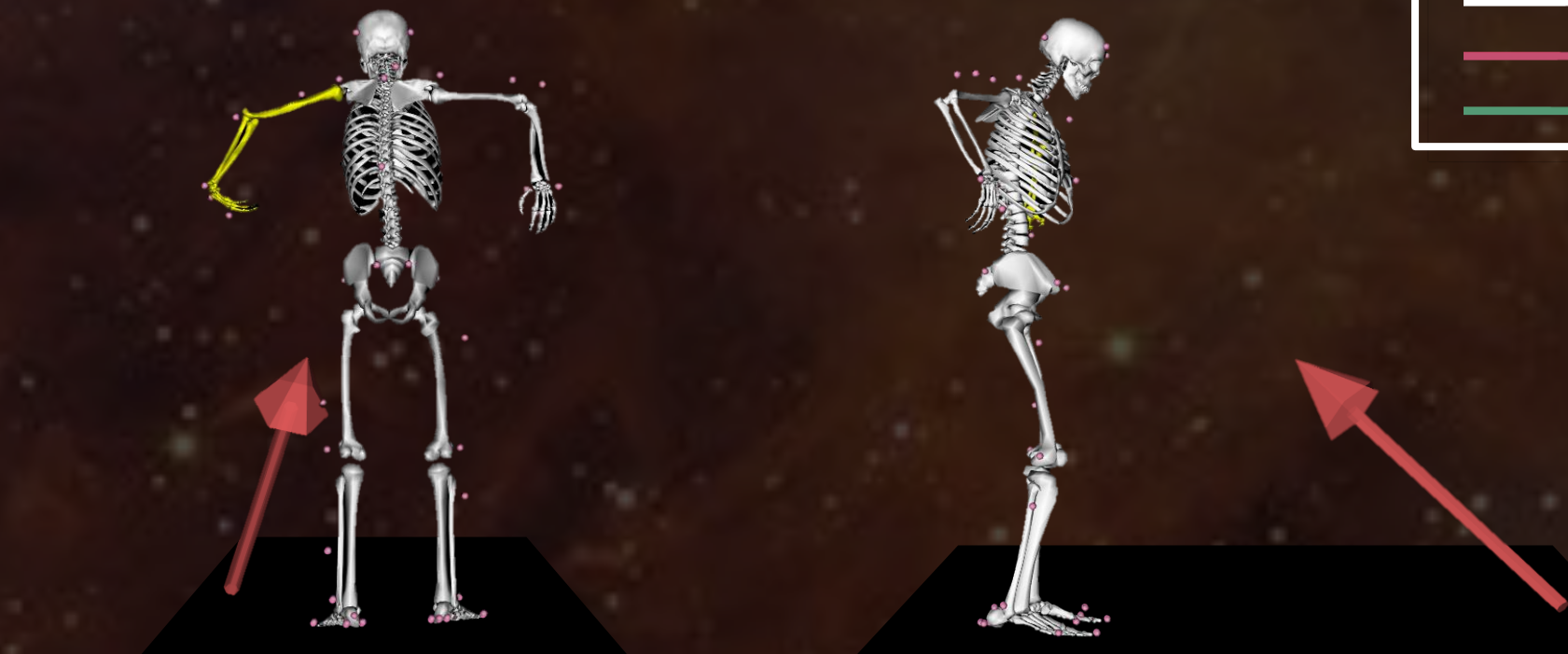
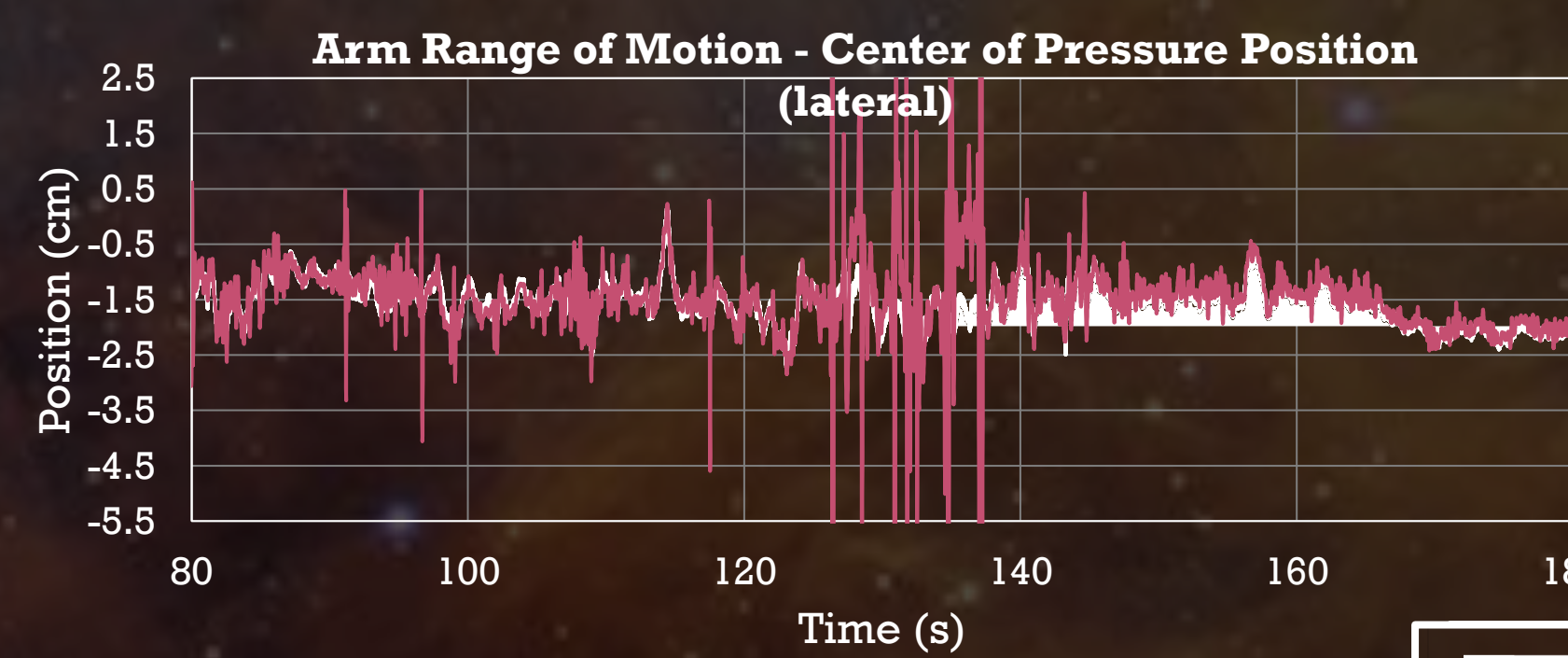
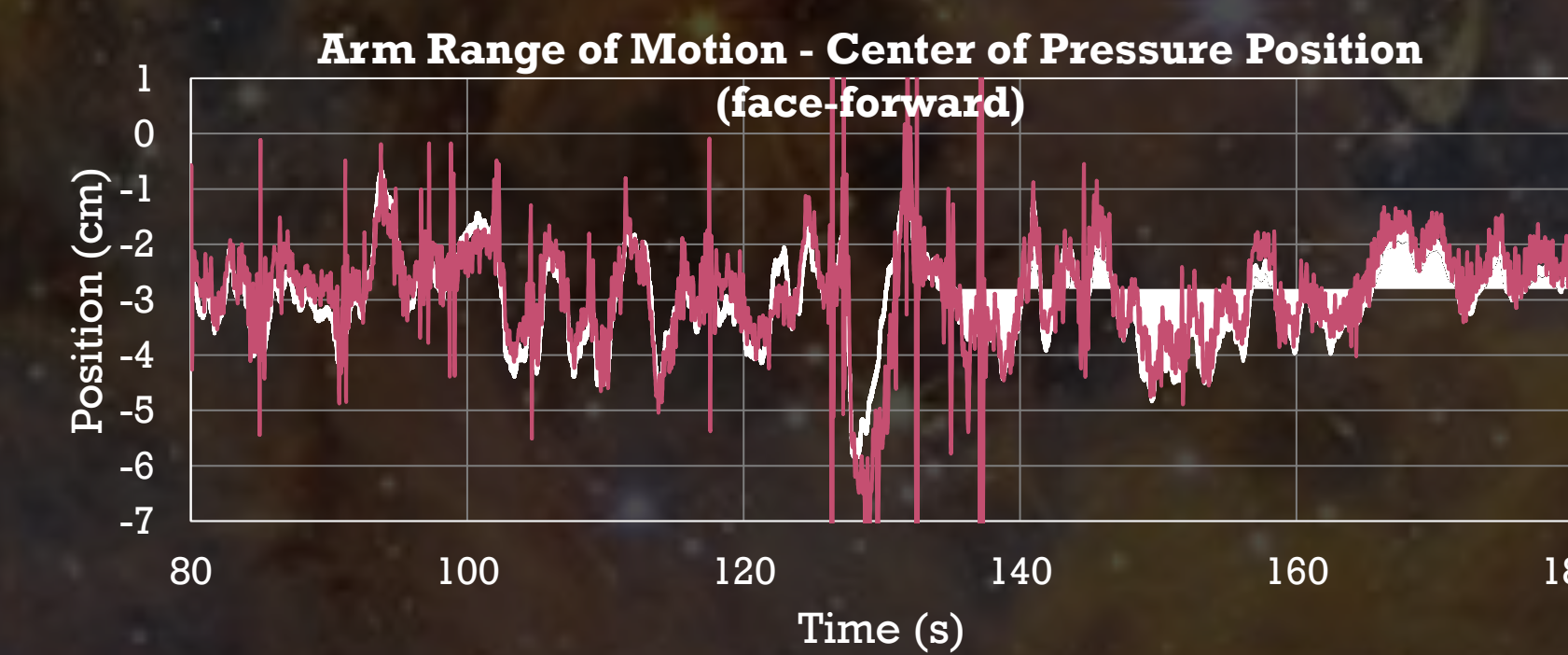
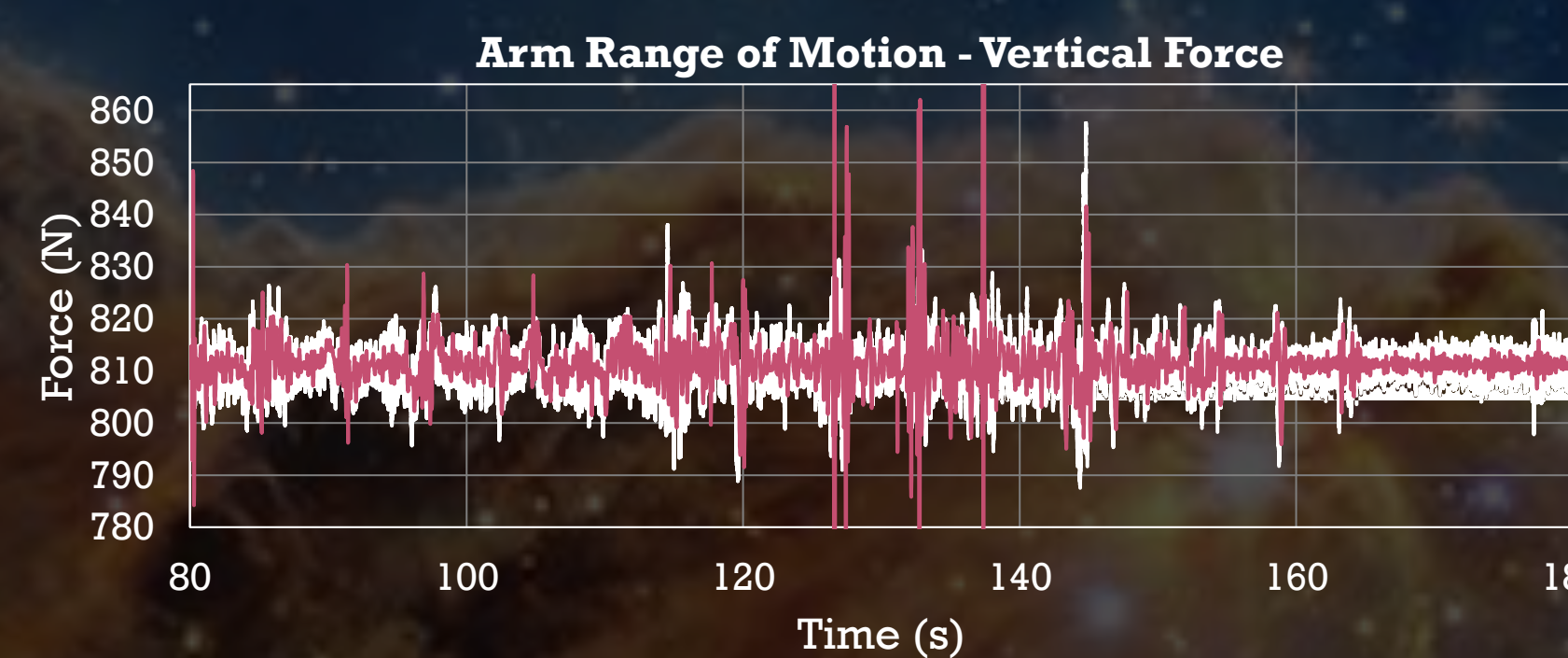
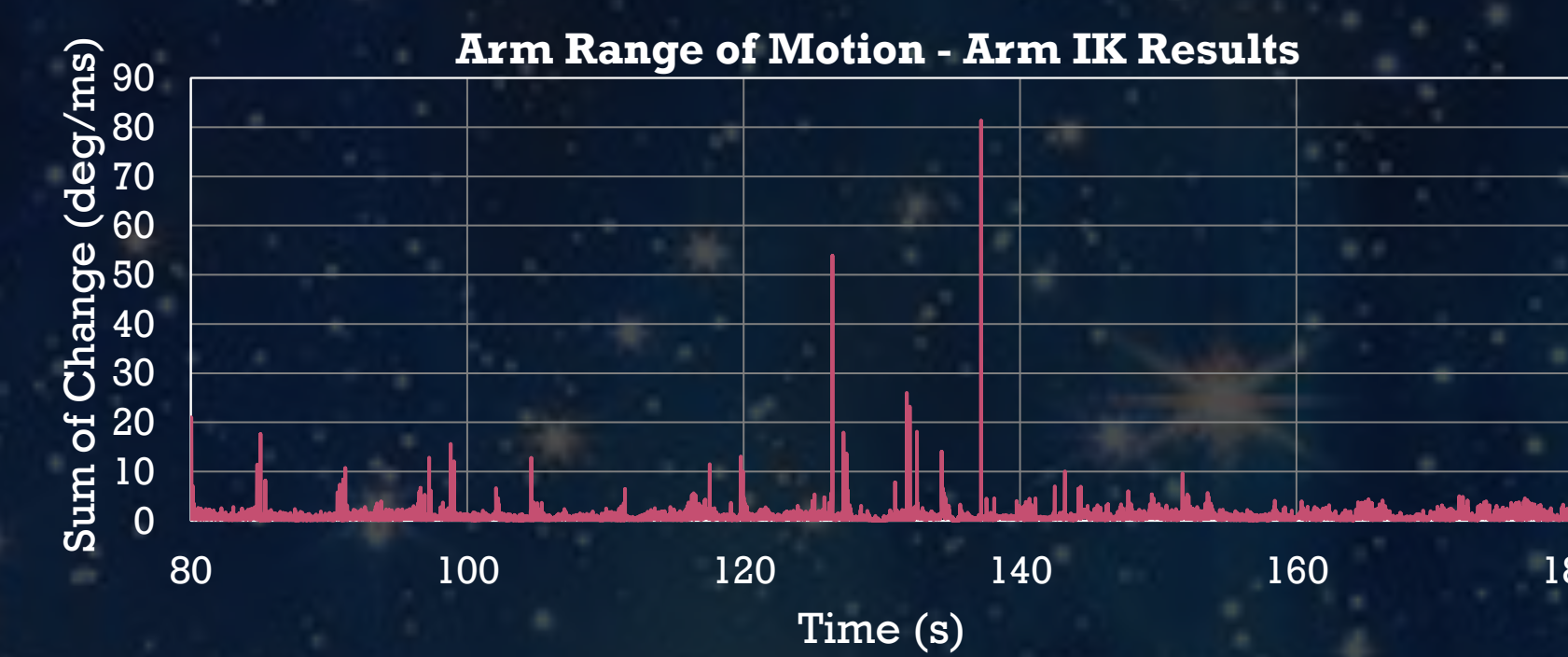
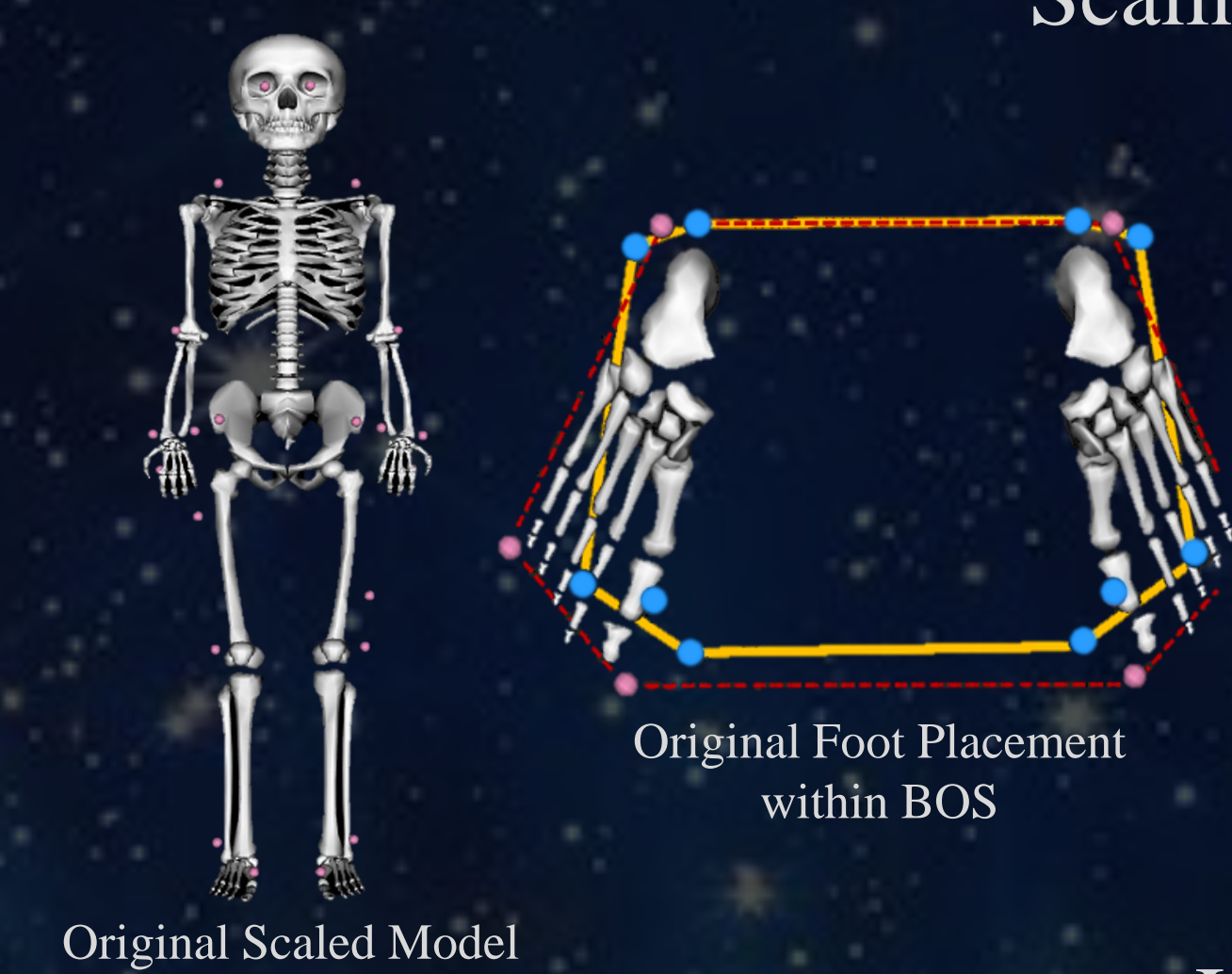
Changes to IK Marker Set



Changes to Arm Axes of Rotation

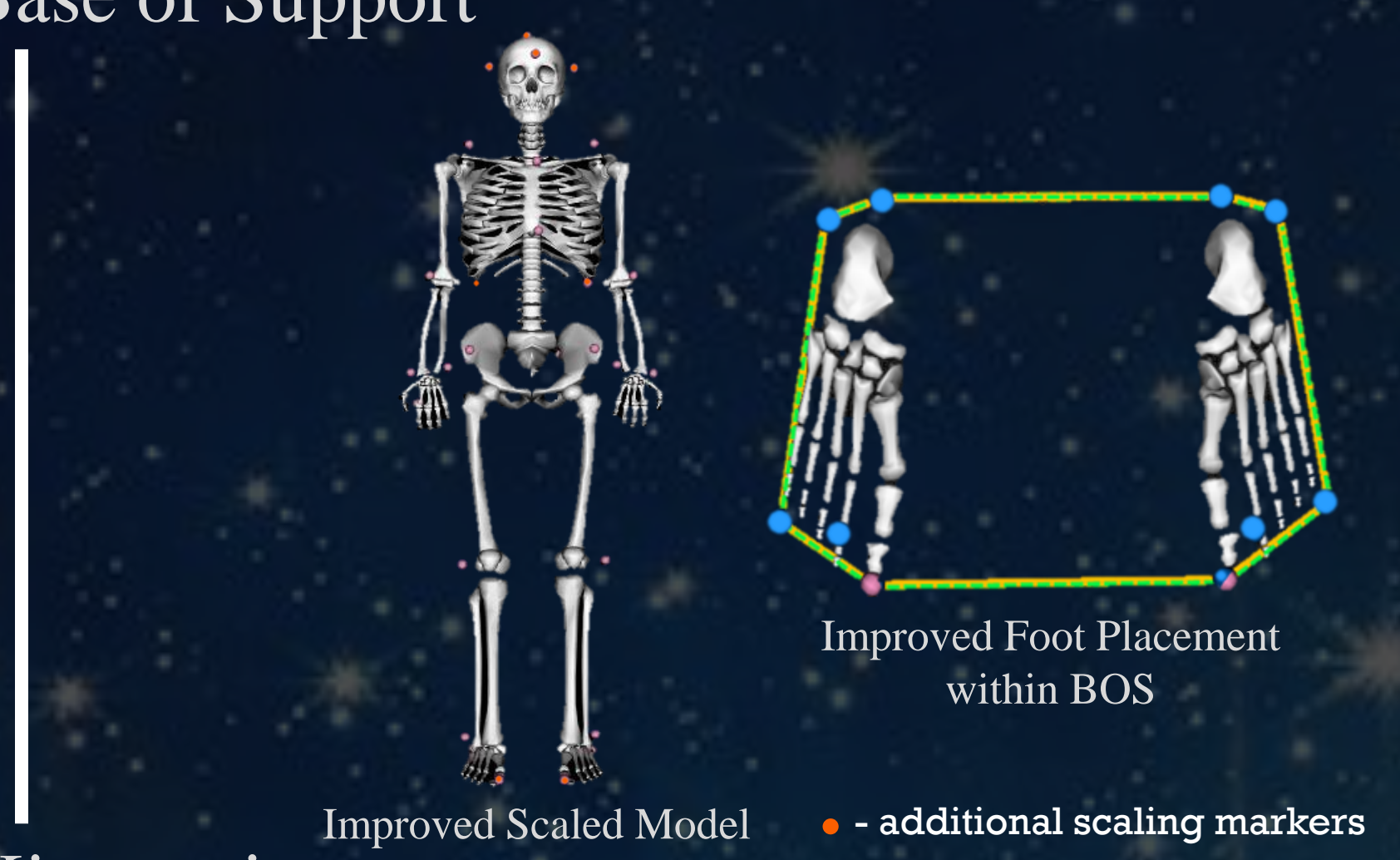


Original Results

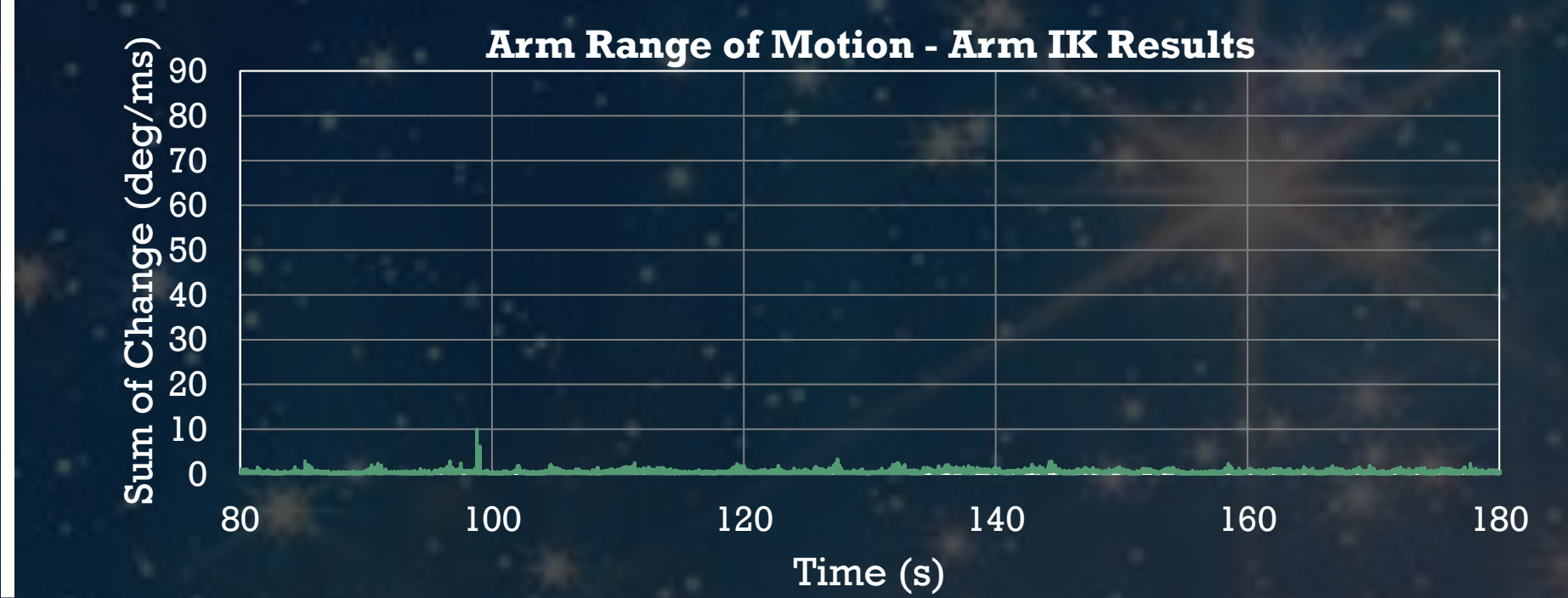


Improved Results

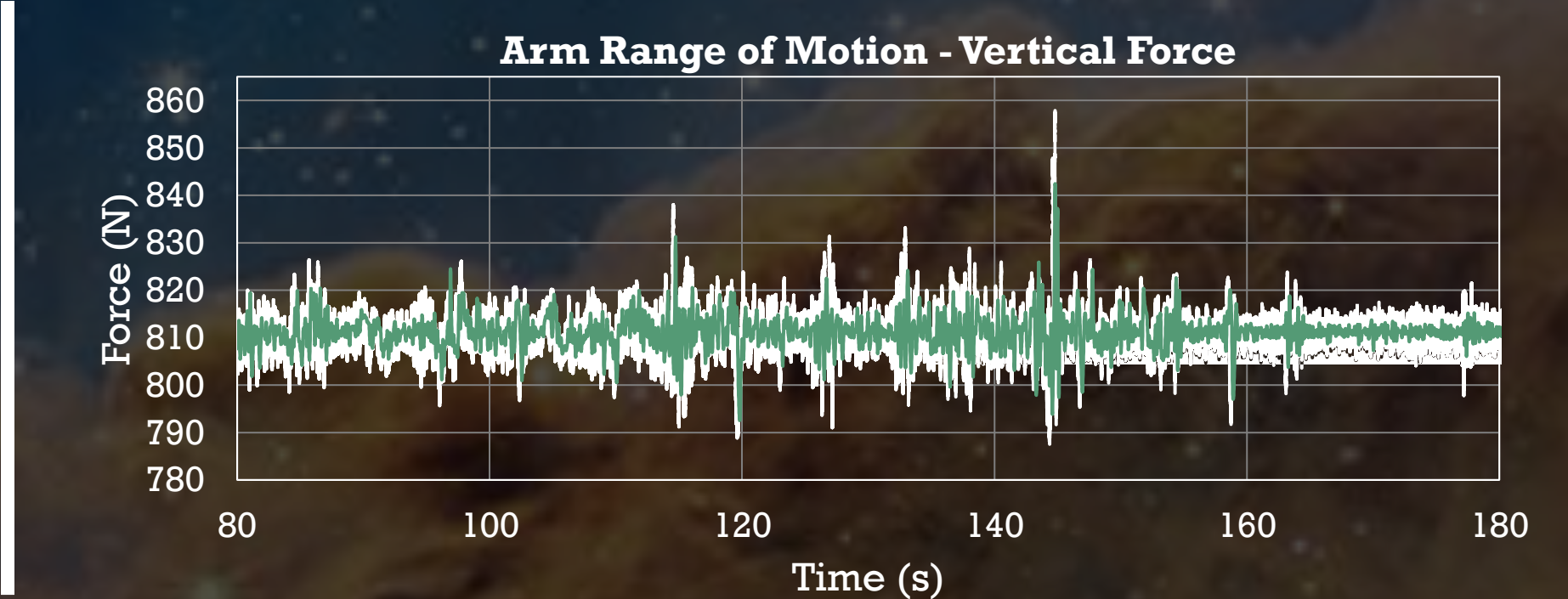
Scaling and Base of Support



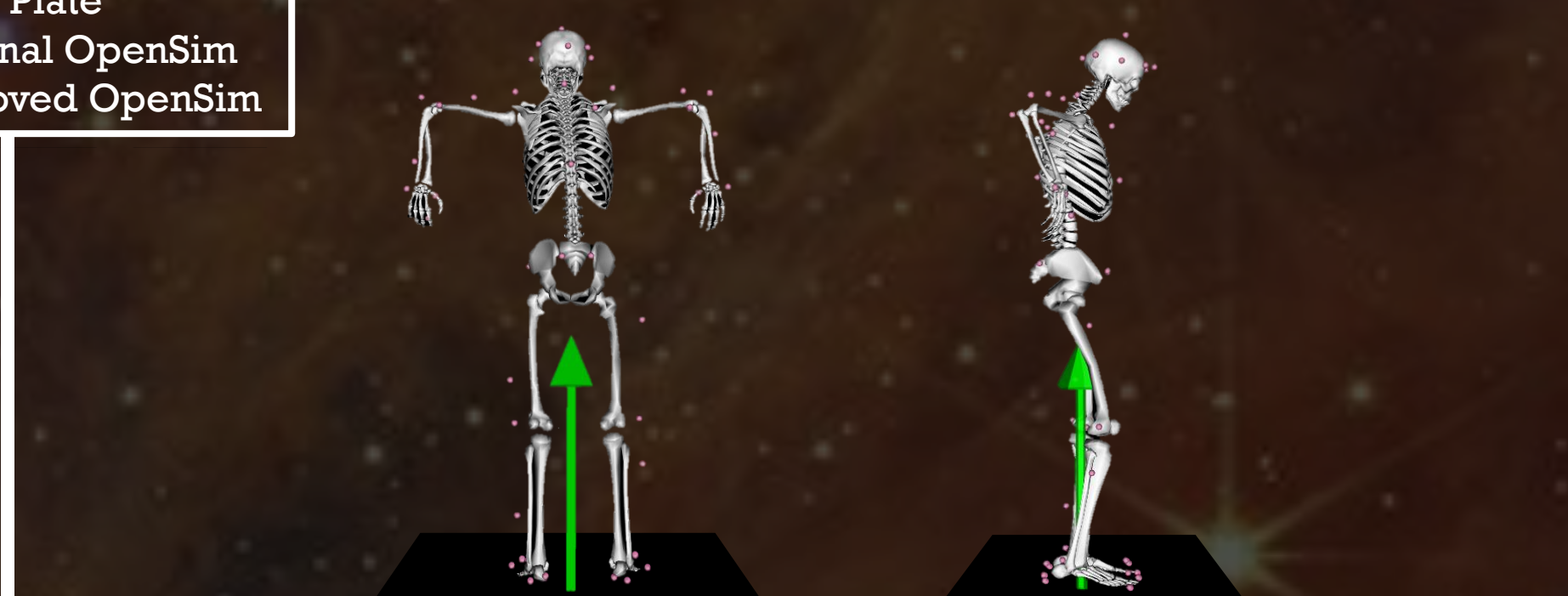
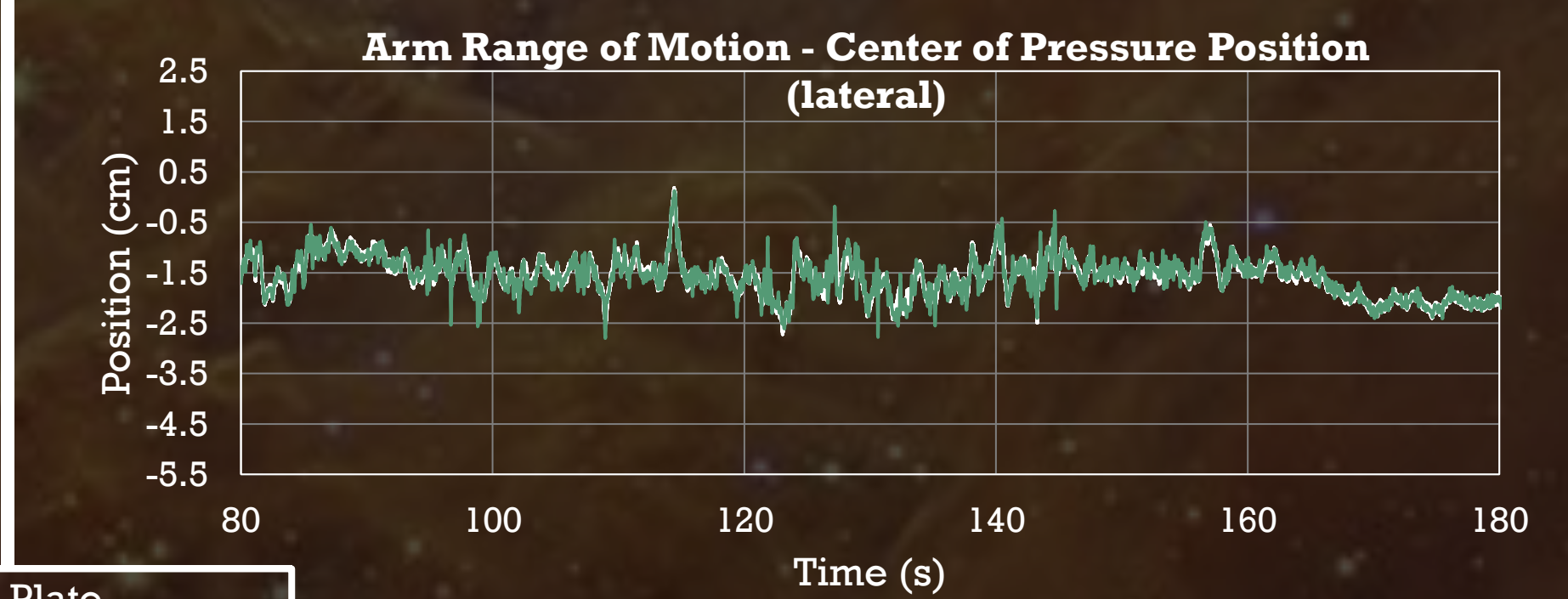
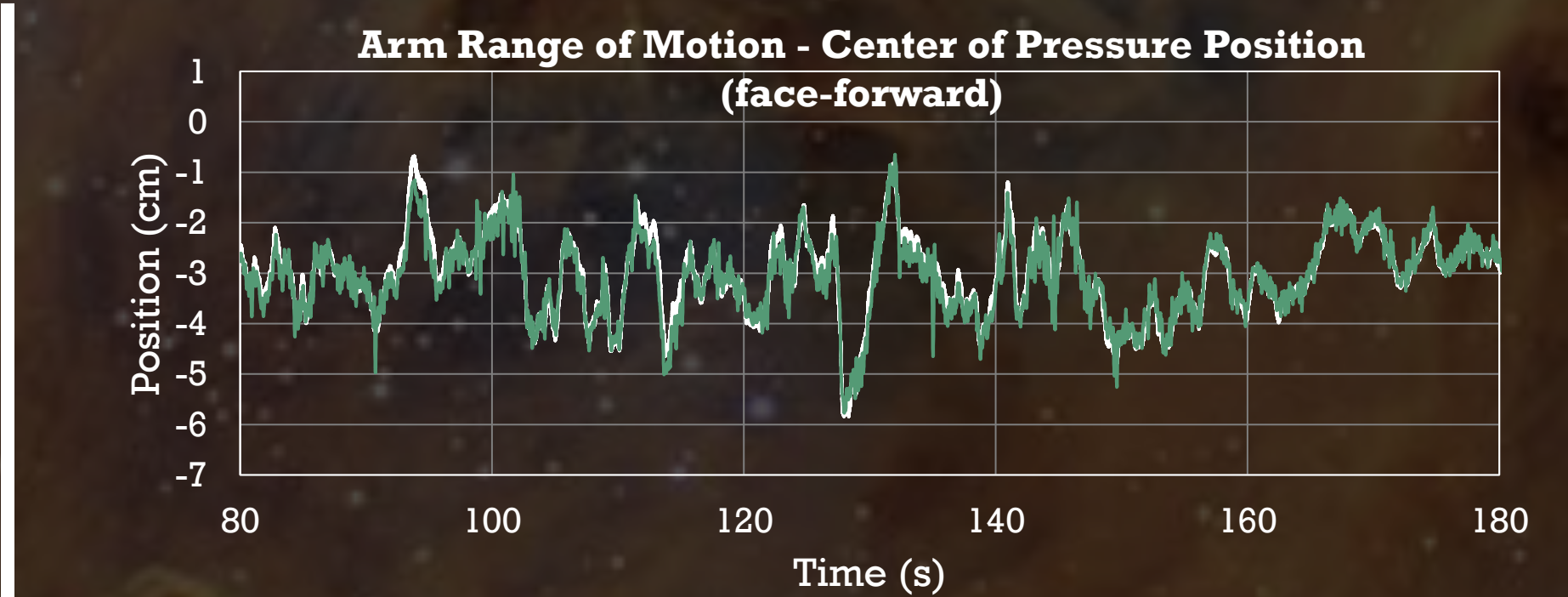
Inverse Kinematics



Ground Reaction Force



Center of Pressure



Conclusions

- Improved automated marker-based model scaling results
- Improved accuracy of BOS estimation
- More reasonable joint angle rates of change
- Removed spikes in ground reaction force and COP results

Challenges

- Stabilize arms retroactively for datasets lacking medial elbow markers
- Determine solutions that can be applied in all situations rather than on a case-by-case basis
- Verify scaled model mass distribution reflects individualized body types

Acknowledgments

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References

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