GENERALIZABLE DEEP LEARNING MODEL ENABLES PREDITION OF FUTURE PHYSIOLOGICAL STATES DURING PERTURBED LOCOMOTION

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Can we assist **balance recovery** by enabling **faster-than-human** exoskeleton control?

Falling is a leading cause of injury related death in older adults [1].

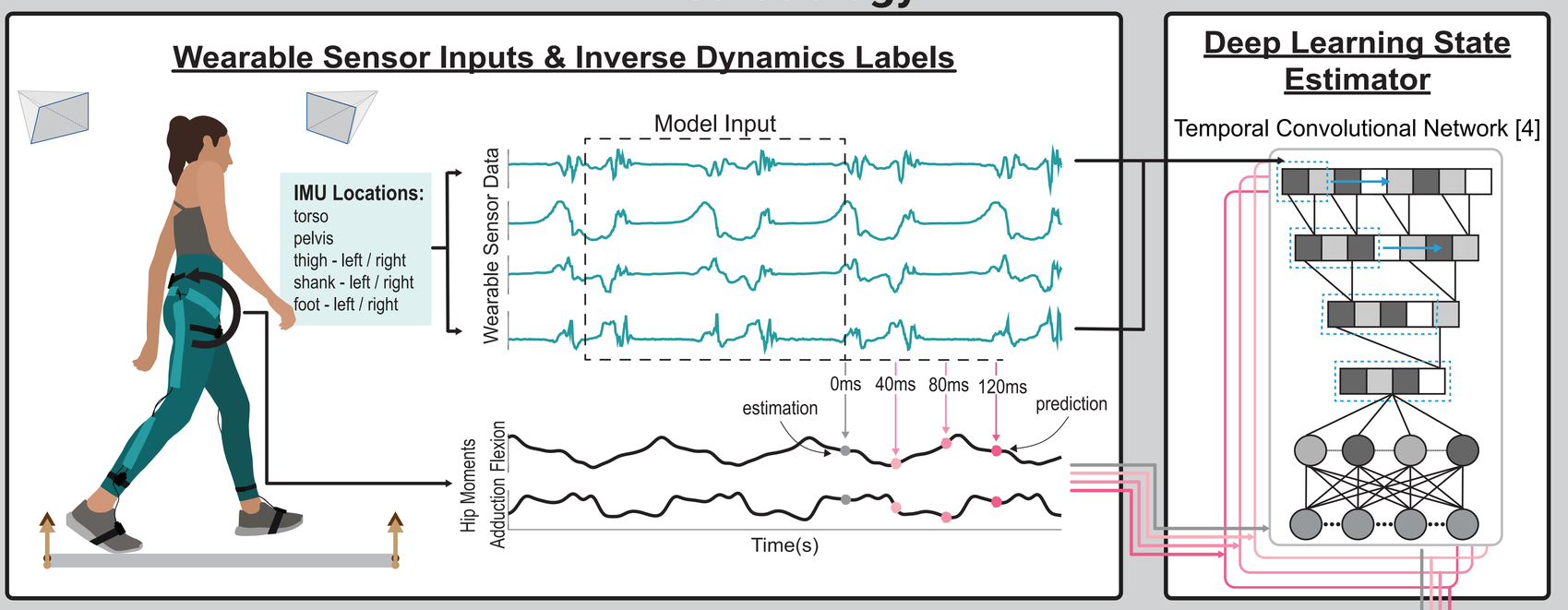
- Deep learning-based controllers have been shown to generalize across cyclic and non-cyclic tasks [2].
- We can augment balance by leading the human neurological response [3]

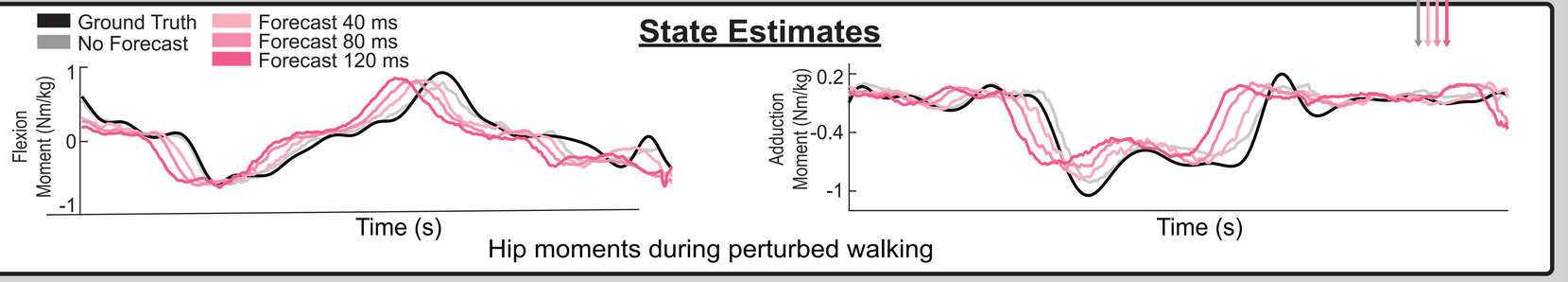
Hypothesis

(1) A deep learning-model will outperform the average biomechanical response to a perturbation when **forecasting** joint moment

(2) Our model will **generalize** to unseen perturbation conditions

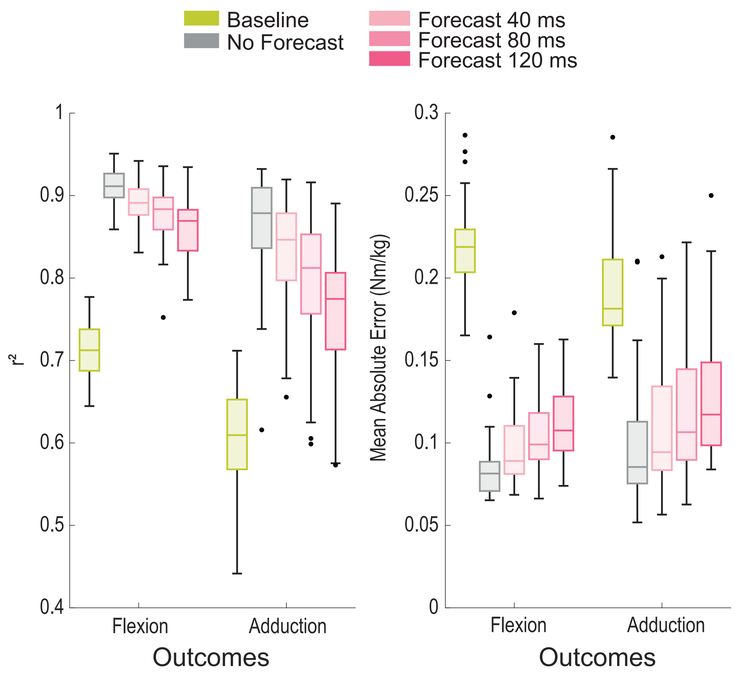
Methodology





Hip moments during perturbed walking

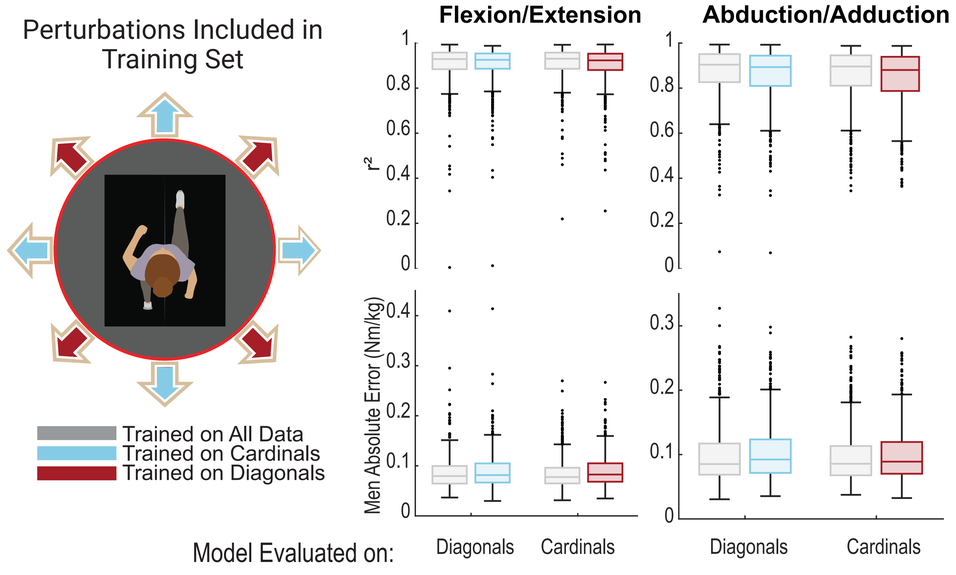
1 Can we forecast future hip moments using causal sensor inputs?



We can reliably **forecast** future physiological states during perturbed locomotion

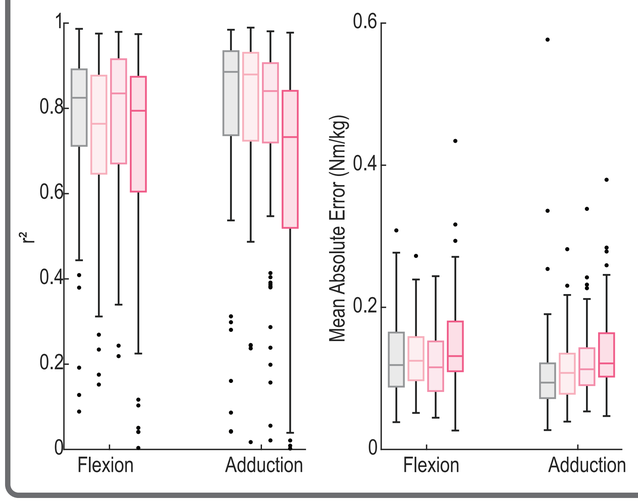
Our model can outperform an a best-case **baseline** in estimating and predicting novel subject's hip moments

2 Can our model generalize to unseen perturbation conditions?



Our model can **generalize** to perturbations outside of the training set

Online Deployment: Forecast



Citations
[1] Kakara et al. (2023), Morb. Mortal. Wkly. Rep.
[2] Molinaro & Scherpereel (2024), Nature.
[3] Beck et al. (2023), Sci. Rob.
[4] Molinaro et al. (2024), Sci. Rob.

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