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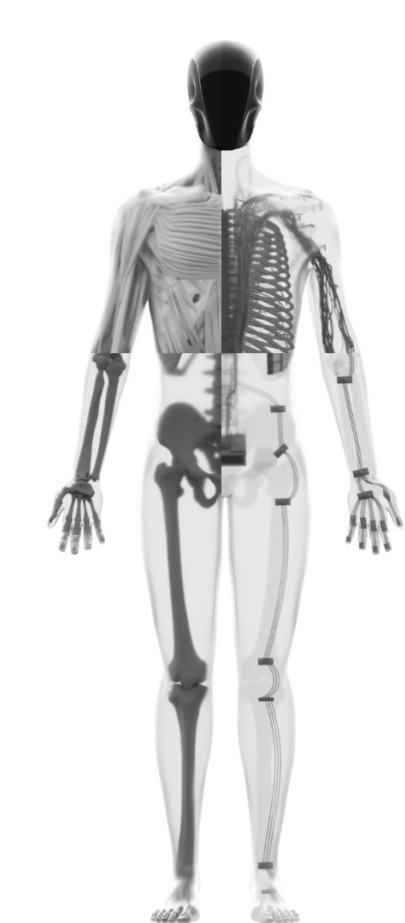


TWIST: Teleoperated Whole-Body Imitation System

Yanjie Ze^{1*} Zixuan Chen^{2*} João Pedro Araújo^{1*} Zi-ang Cao¹
Xue Bin Peng² Jiajun Wu^{1†} C. Karen Liu^{1†}



Motivation



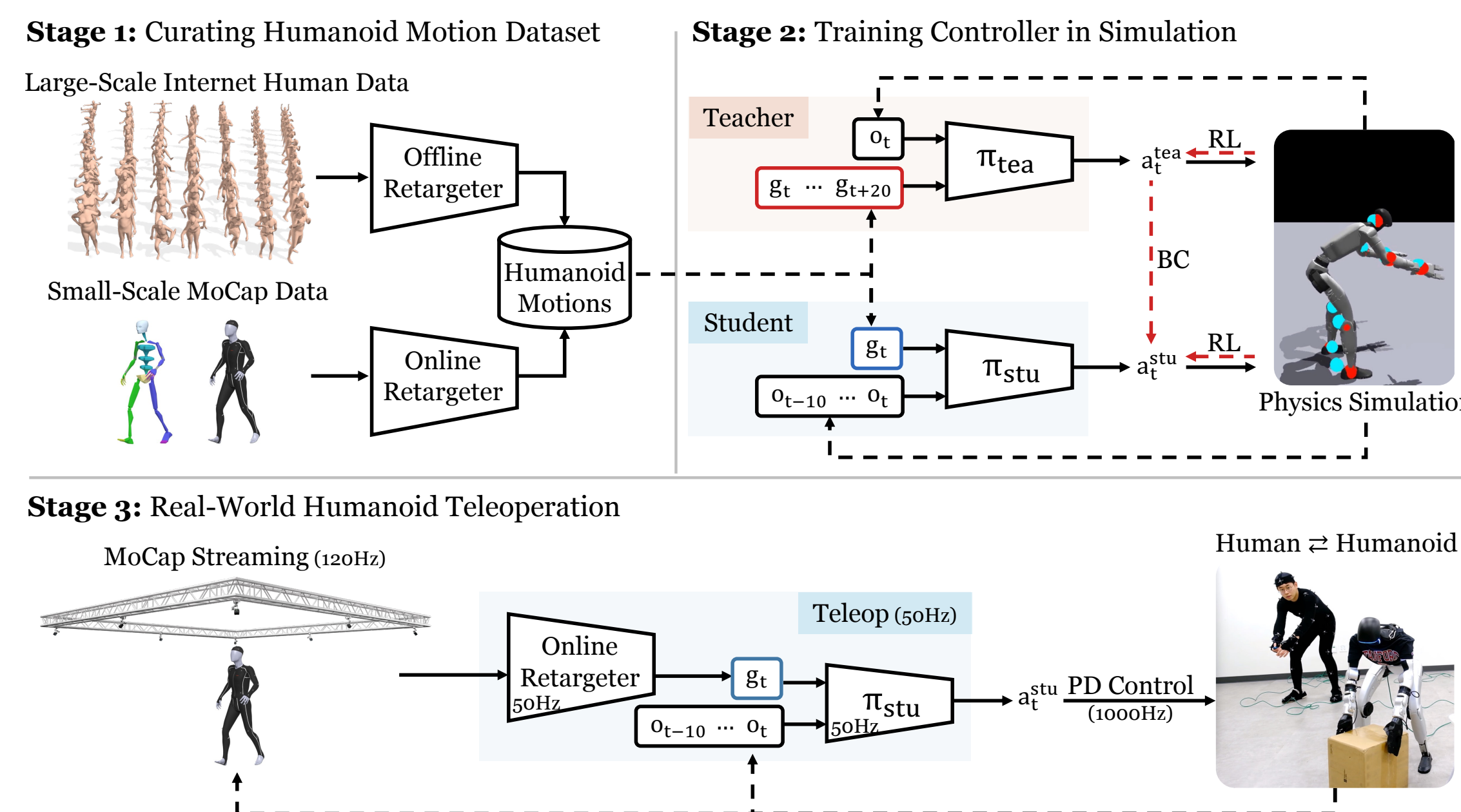
- Humans have **whole-body dexterity**.



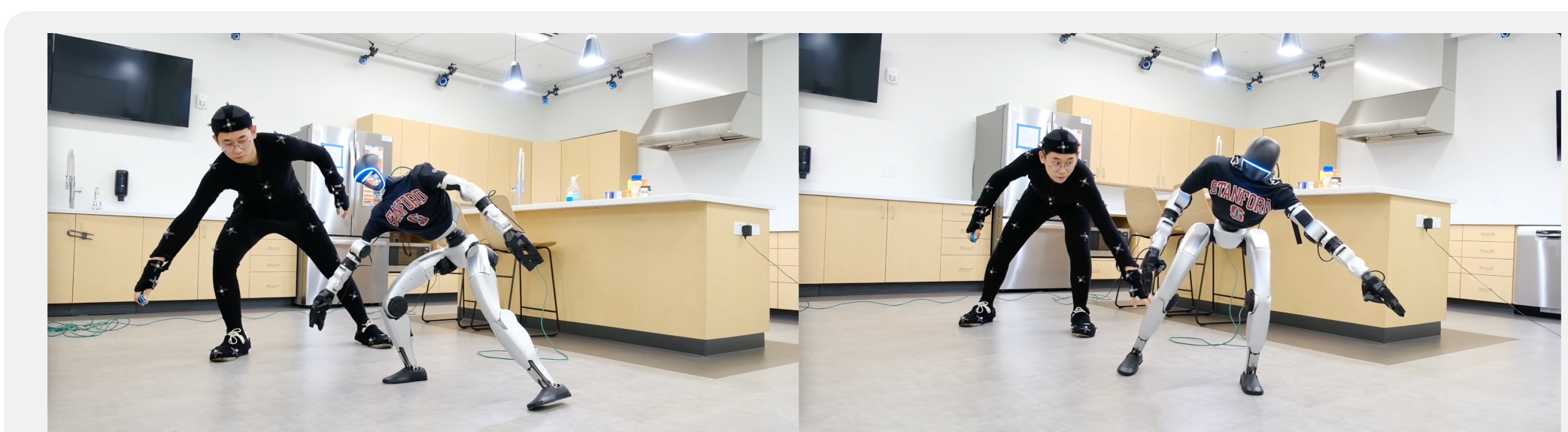
- Use Feet to Kick Crouch and Reach Use Elbow to Push
- Prior teleoperation systems fail to achieve such coordinated whole-body behaviors.
- We ask: **can we achieve human whole-body dexterity for humanoid robots?**
- Key idea: **let robots imitate whole-body humans.**

Our System: TWIST

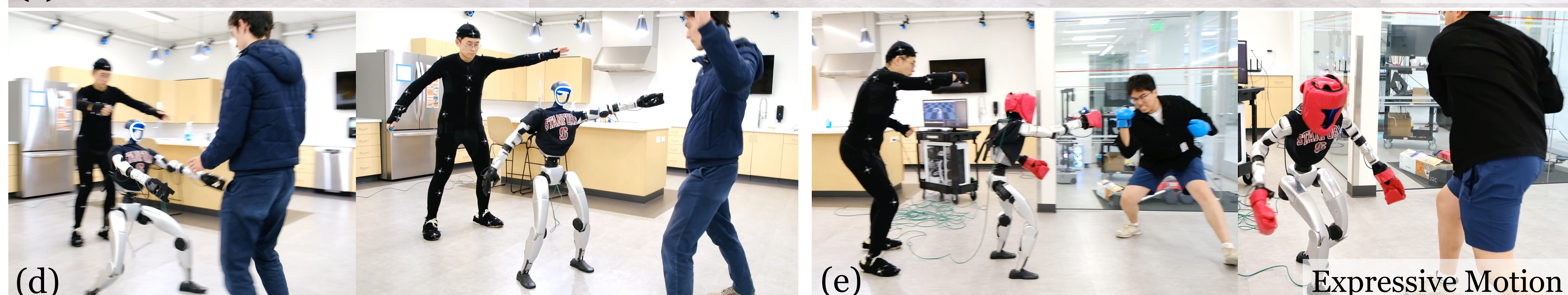
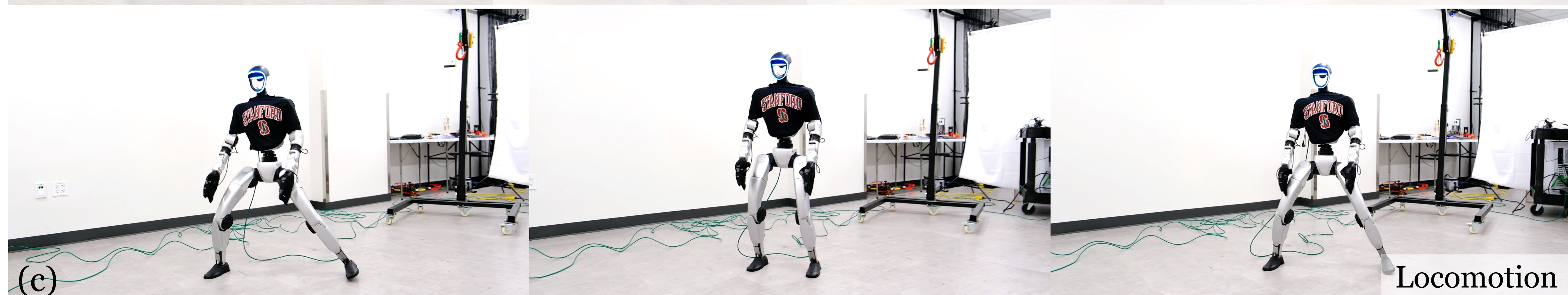
- Stage 1:** curating a large-scale humanoid motion dataset.
- Stage 2:** training a tracking controller in physics simulation.
- Stage 3:** teleoperating real-world humanoid robots with MoCap data.



- Extreme reachability:** TWIST achieves human-like whole-body reachability, fully leveraging whole-body robot joints.

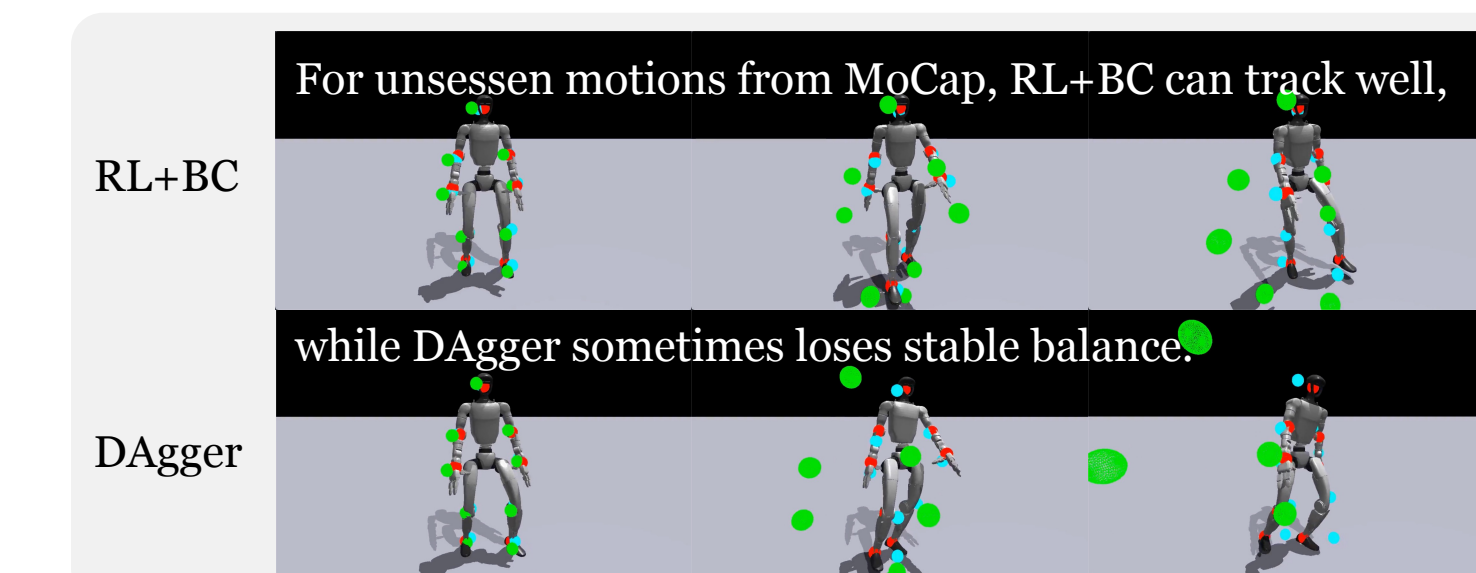
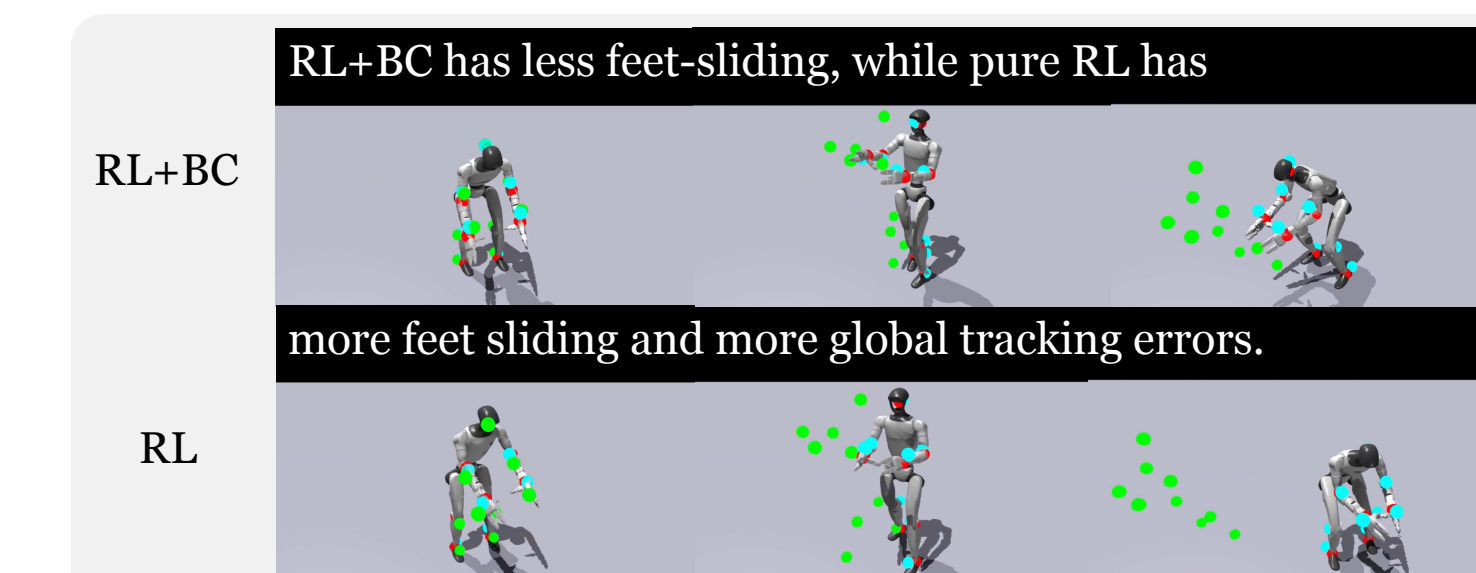


TWIST enables versatile, coordinated, whole-body skills.

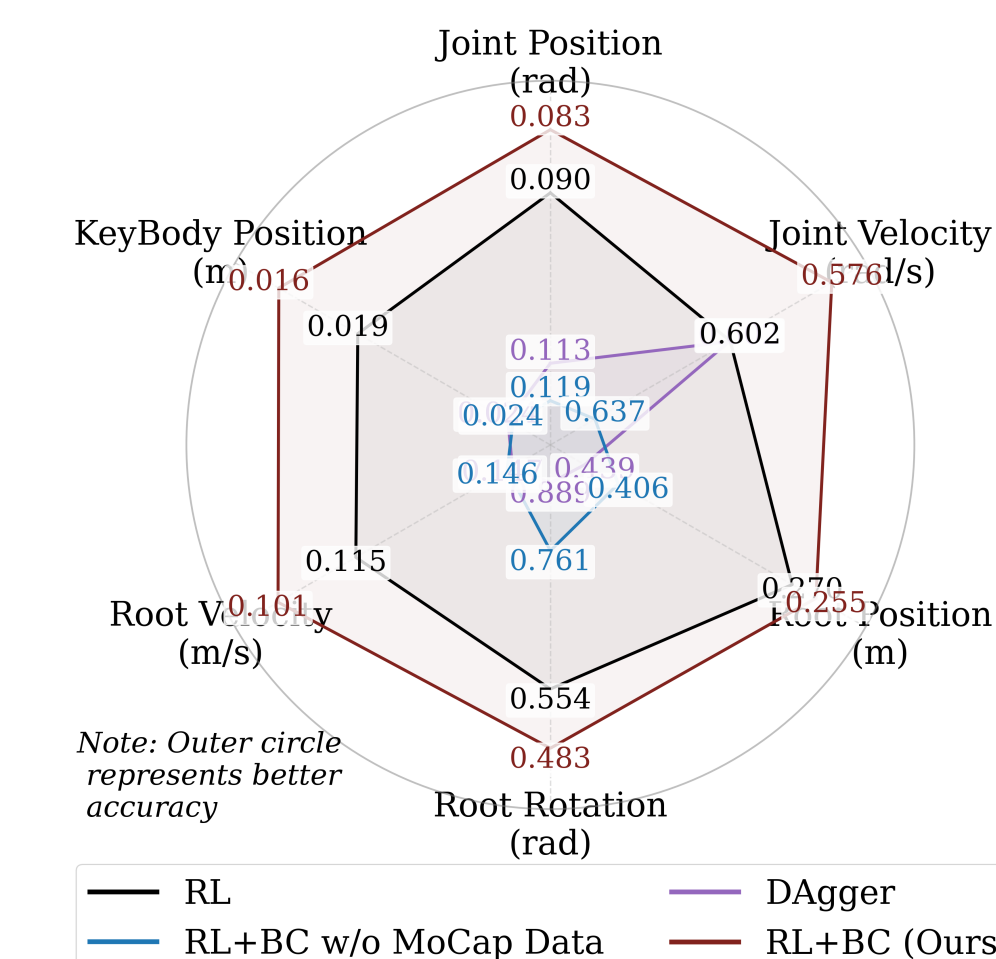


System Analysis

- Problem of pure RL:** feet sliding/no smooth behavior.
- Problem of pure BC:** not generalize to OOD motions.
- Simple fix:** $L(\pi_o) = L_{RL}(\pi_o) + \lambda D_{KL}(\pi_o \parallel \pi_s)$



- Problem of only Internet data:** noisy and unstable real-world MoCap motions.
- Simple fix:** collect a small-scale in-house data.



- We study tracking errors across different body parts.
- The feet exhibit the largest errors**, highlighting the difficulty in accurately tracking lower-body movements.

