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UNIVERSITY OF MICHIGAN

Let Humanoids Hike! Integrative Skill Development on Complex Trails

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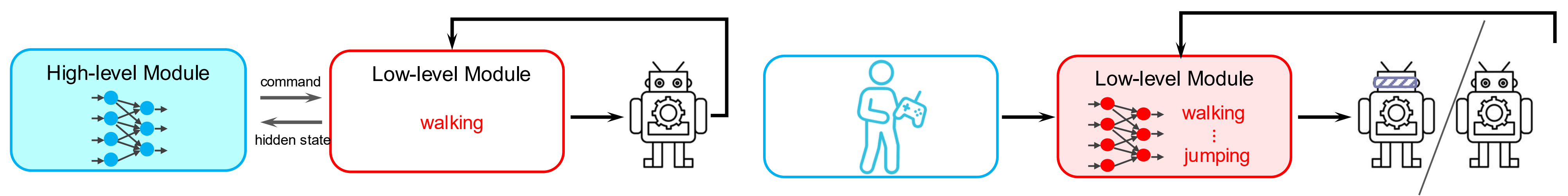
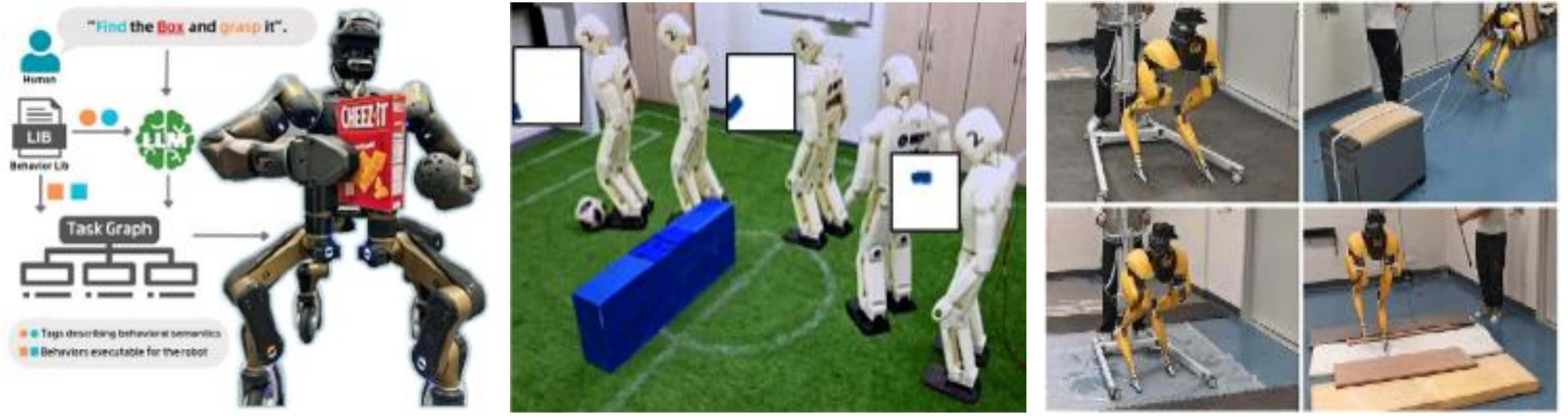
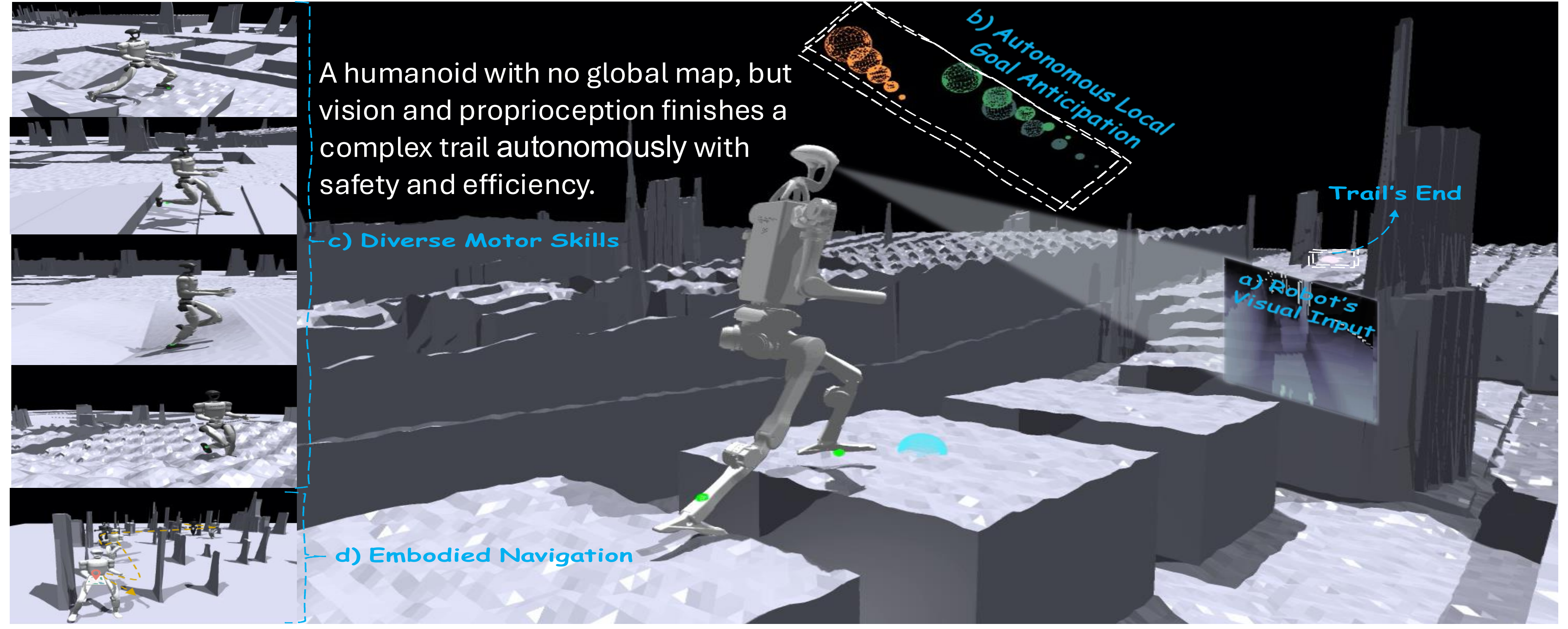
Past Work: Disjoint Skill Learning → Lack Autonomy



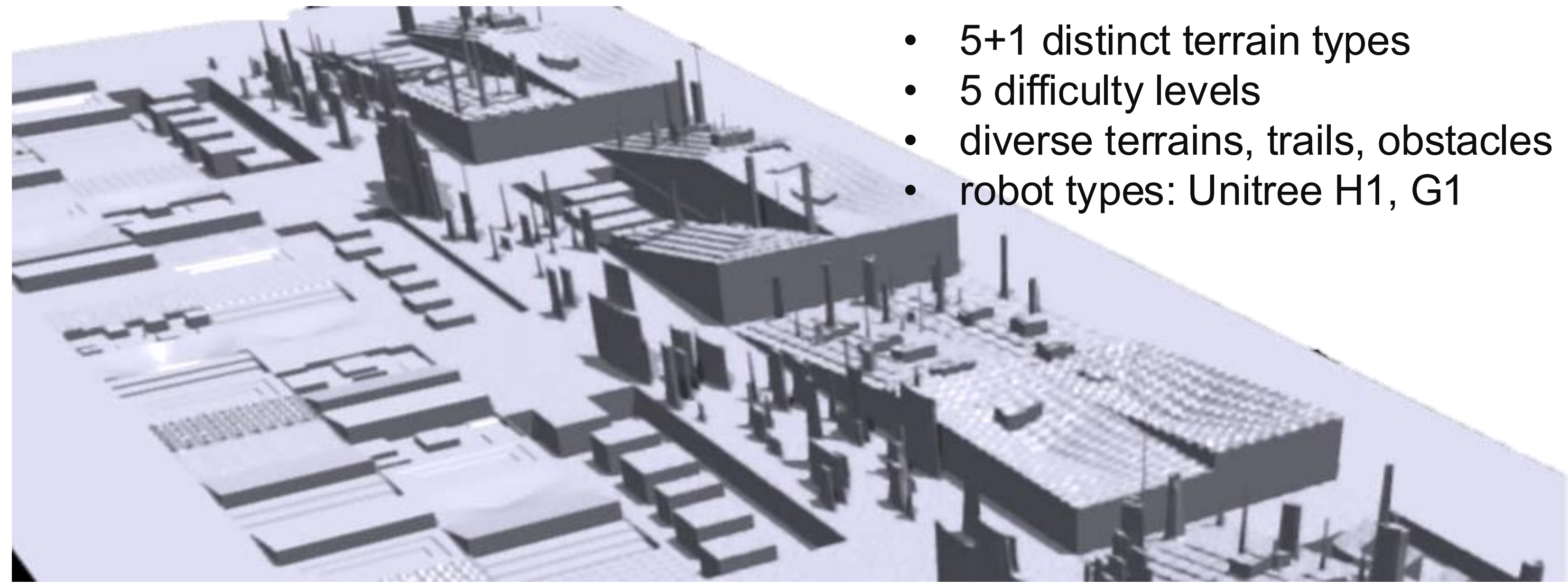


Hiking Demands Visual, Decisional, Motor Autonomy

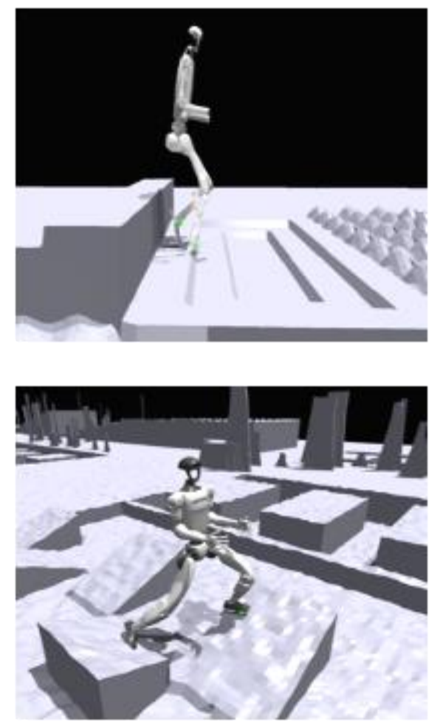


A humanoid with no global map, but vision and proprioception finishes a complex trail autonomously with safety and efficiency.

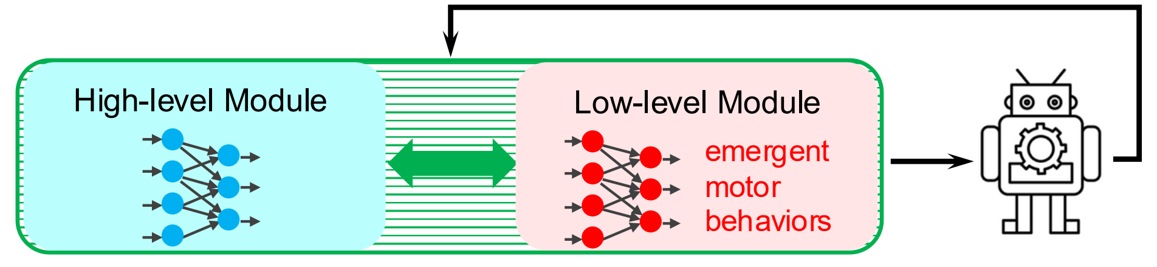
First Humanoid Hiking Playground and Benchmark



- 5+1 distinct terrain types
- 5 difficulty levels
- diverse terrains, trails, obstacles
- robot types: Unitree H1, G1

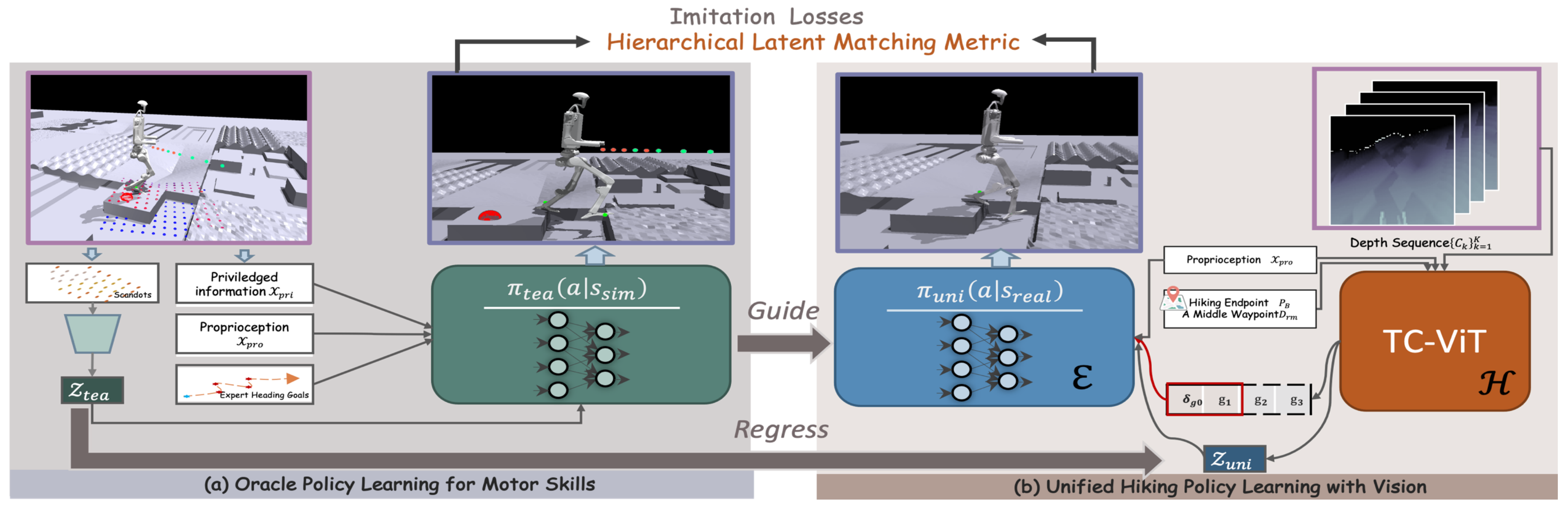


LEGO-H: Navigation/Locomotion in A Unified Policy

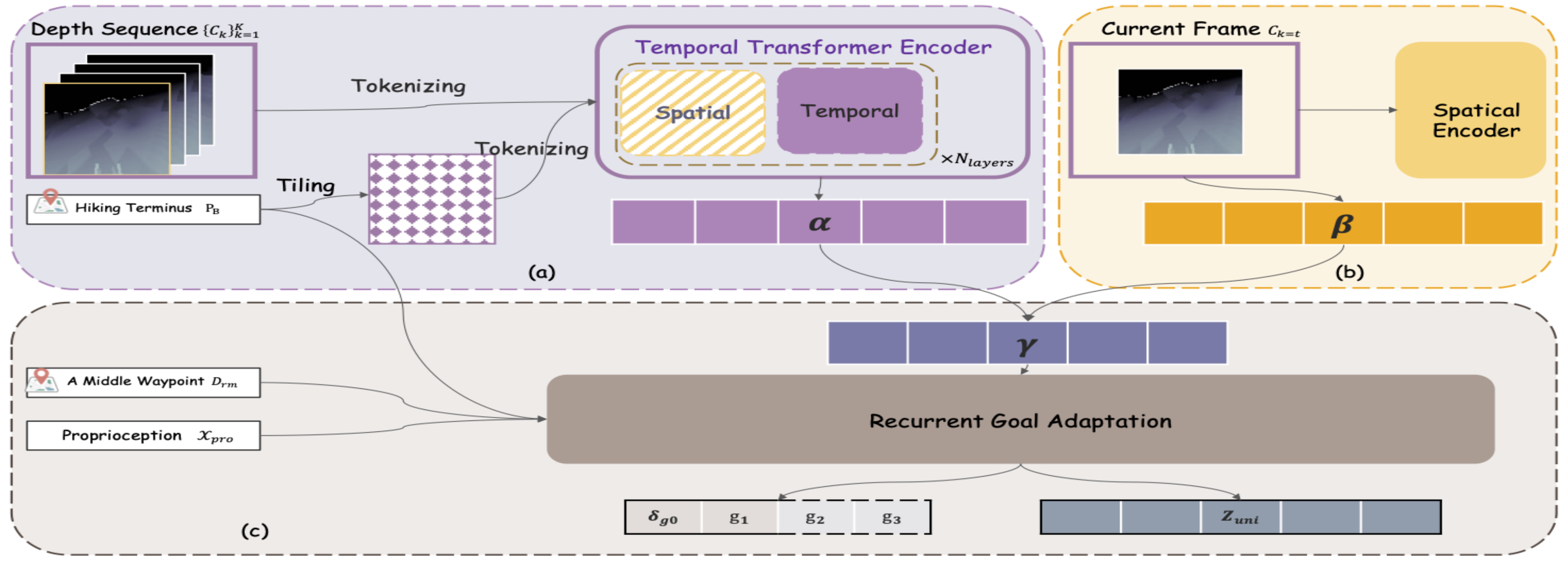


Key-1:Turn High-level Policy to Local Goal Anticipation

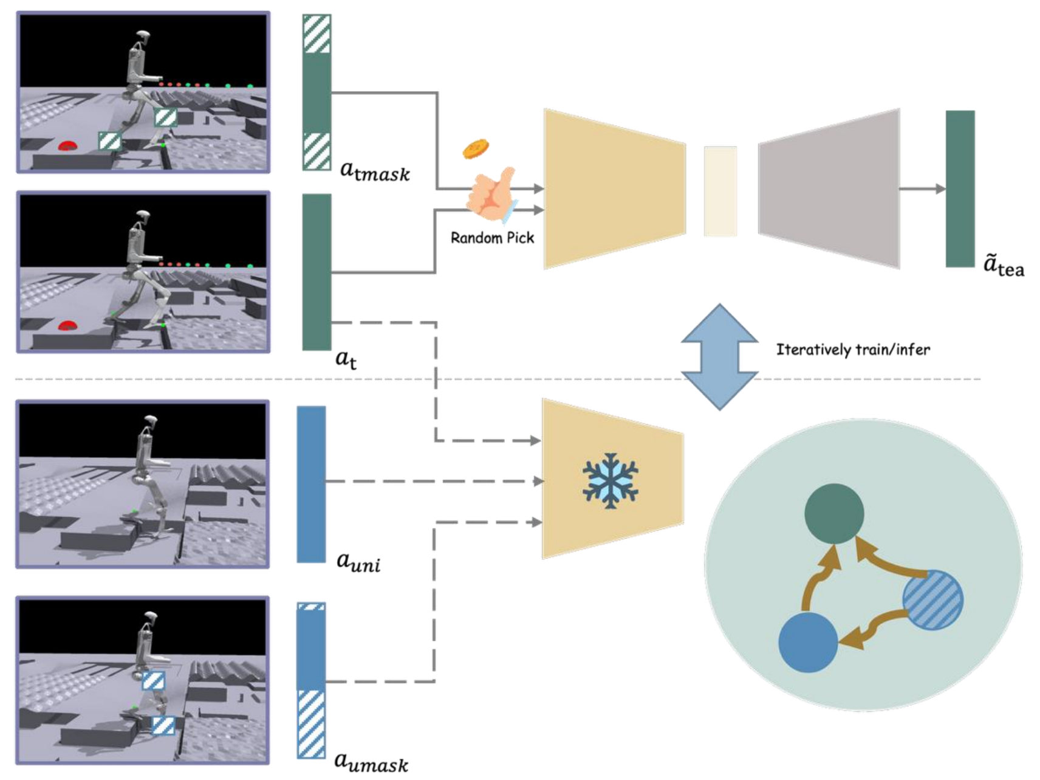
Key-2: Improve Locomotion w Hierarchical Latent Match



Autonomous Local Goal Anticipation upon Hierarchical RL



Hierarchical Latent Action Matching with Privileged Learning



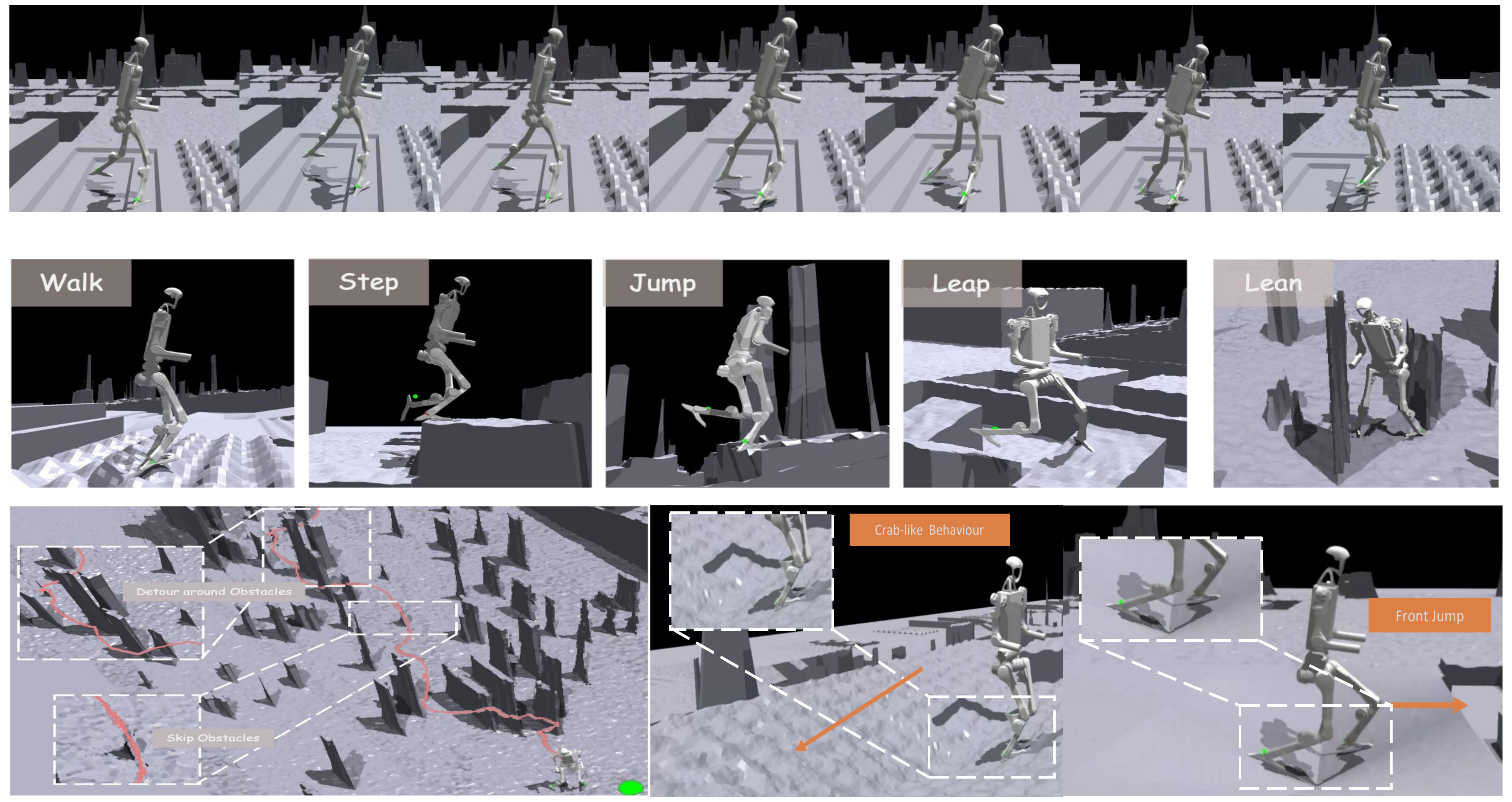
Oracle-derived prior enables robot-specific behaviors without human demos

$$L_{hie} = \omega_{ts} L_{ts} + \omega_{trip} L_{trip}$$

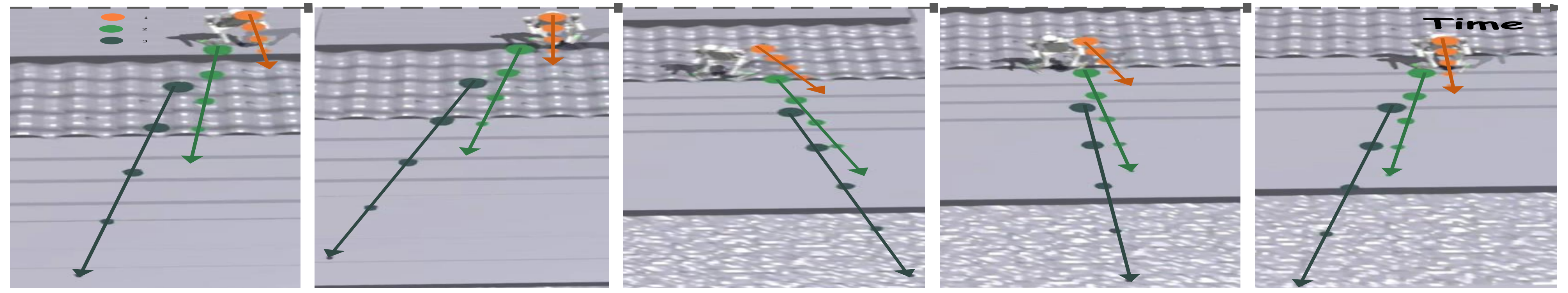
$$\mathcal{L}_{ts} = 1 - \text{cos\_sim}(\text{Enc}(\mathbf{a}_{tea}), \text{Enc}(\mathbf{a}_{uni})) = 1 - \frac{\text{Enc}(\mathbf{a}_{tea}) \cdot \text{Enc}(\mathbf{a}_{uni})}{\|\text{Enc}(\mathbf{a}_{tea})\| \|\text{Enc}(\mathbf{a}_{uni})\|}$$

$$\mathcal{L}_{trip} = c_{mt}(1 - \text{cos\_sim}(\text{Enc}(\mathbf{a}_{tea}), \text{Enc}(\mathbf{a}_{umask}))) + c_{ms}(1 - \text{cos\_sim}(\text{Enc}(\mathbf{a}_{uni}), \text{Enc}(\mathbf{a}_{umask})))$$

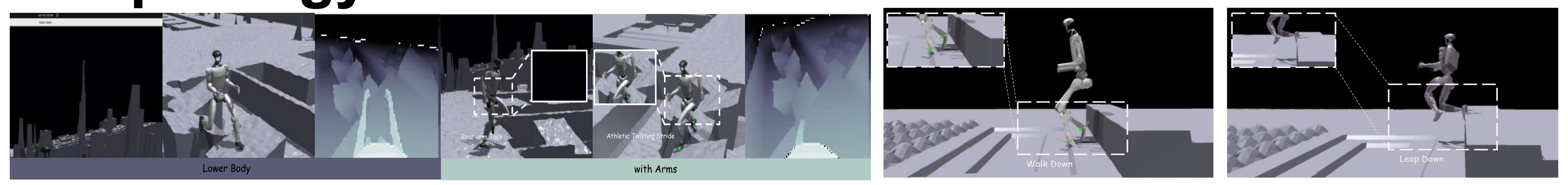
Emergent Diverse Behaviors and Generalization



Near Goal Dynamic Adjustments



Morphology Influences Behaviors



Benchmarks → Vision and Unified Policy Essential