

Supplementary Materials for HumanPlus: Humanoid Shadowing and Imitation from Humans

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1 Videos of all the tasks can be found at <https://humanplus-sub.github.io>.

2 1 Details on Humanoid Shadowing Transformer

Environment Params	Ranges
base payload	$[-3.0, 3.0]\text{kg}$
end-effector payload	$[0, 0.5]\text{kg}$
center of base mass	$[-0.1, 0.1]^3\text{m}$
motor strength	$[0.8, 1.1]$
friction	$[0.3, 0.9]$
control delay	$[0.02, 0.04]\text{s}$

Table 1: **Randomization in Simulation.** We uniformly sample from these randomization ranges during training in simulation.

Reward Teams	Expressions	Weight
target xy velocities	$\exp(- v_x, v_y - [v_x^{\text{tg}}, v_y^{\text{tg}}])$	0.5
target yaw velocities	$\exp(- v_{\text{yaw}} - v_{\text{yaw}}^{\text{tg}})$	0.5
target joint positions	$- q - q^{\text{tg}} _2^2$	3
target roll & pitch	$- [r, p] - [r^{\text{tg}}, p^{\text{tg}}] _2^2$	3
energy	$- \tau \dot{q} _2^2$	2e-5
feet slipping	$- v_{\text{feet}} \cdot \mathbb{1}[F_{\text{feet}} > 1] _2$	1
alive	1	1

Table 2: **Rewards in Simulation.** We denote v_x as linear x velocity, v_y as linear y velocity, v_{yaw} as angular yaw velocity, q as joint positions, \dot{q} as joint velocities, r as roll, p as pitch, v_{feet} as feet velocities, F_{feet} as forces on feet, and \cdot^{tg} as targets.

3 We list all the reward terms in the Table 2. We randomize the physical parameters of the simulated
4 environment and humanoids with details in Table 1. We list the hyperparameters of PPO in Table 3.

5 2 Details on Humanoid Imitation Transformer

6 We list the hyperparameters of ACT in Table 4 and the hyperparameters of our Humanoid Imitation
7 Transformer in Table 5.

Table 3: Training Hyper-parameters

PPO clip range	0.2
Learning rate	2e-5
Generalized Advantage Estimation λ	0.95
Number of environments	3500
Reward discount factor	0.99
Learning epochs per training batch	5
Number of environment steps per training batch	24
Number of mini-batches per training batch	4
Minimum policy std	0.2

learning rate	1e-5
batch size	48
# encoder layers	6
# decoder layers	6
feedforward dimension	512
hidden dimension	512
chunk size	50
dropout	0.1
backbone	pretrained ResNet18

Table 4: *Hyperparameters of Humanoid Imitation Transformer.*

learning rate	1e-5
batch size	48
# decoder layers	6
image feature loss weight	0.005
feedforward dimension	3200
hidden dimension	512
chunk size	50
dropout	0.1
backbone	pretrained ResNet18

Table 5: *Hyperparameters of ACT.*