Phvsics-based Character Control usina conditional GAIL

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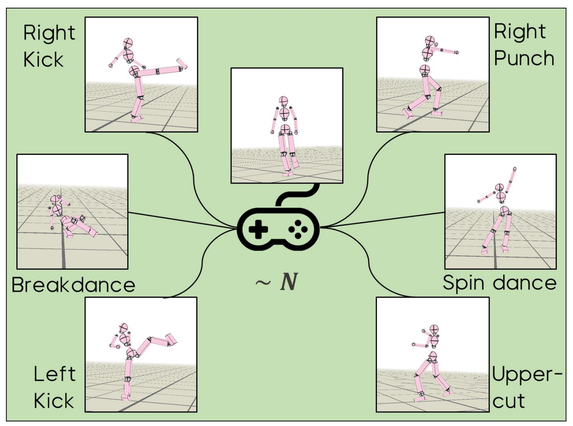
PROBLEM

Character control in physics simulation is one of the long-standing problems in computer graphics. Approaches using Deep-reinforcement learning has improved the performances of Physics-based character control a lot, but still there are many challenges.

- It is difficult to learn multiple motor skills.
- When the number of motions increase, overall motion quality gets degraded.
- Manually-designed rewards are required.

OBJECTIVES

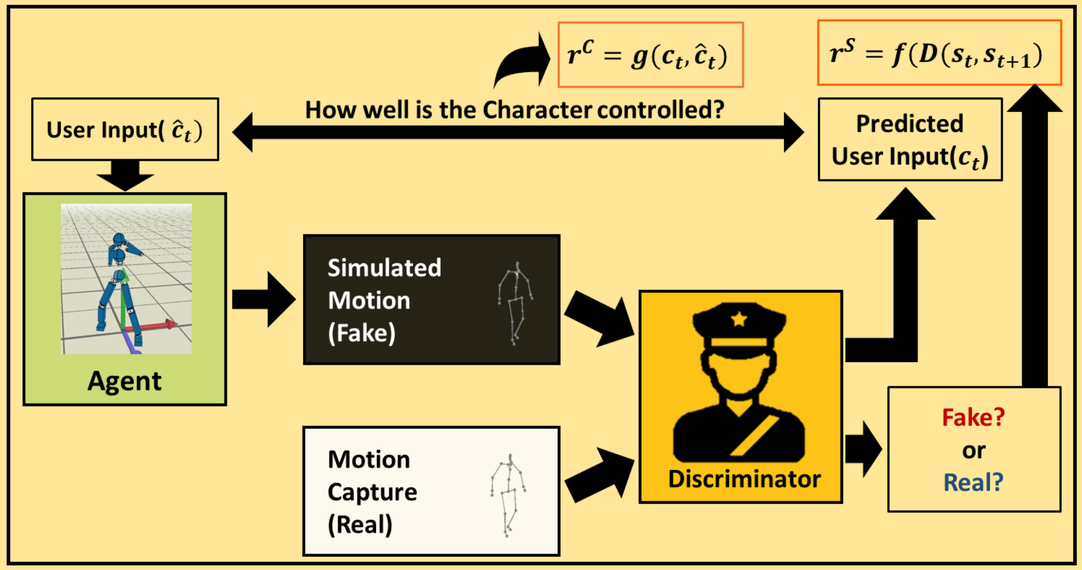
We present a physics-based character controller based on Conditional generative adversarial imitation learning(cGAIL).



The goal of our research is to...

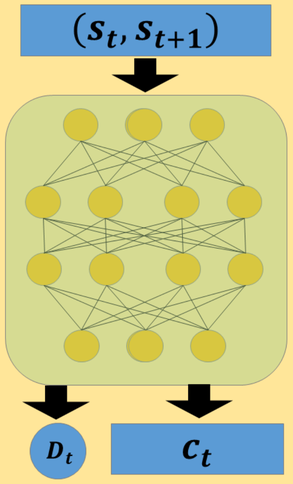
1. enable characters to learn various motor skills from multiple disparate motion clips.
2. change motions following user commands.
3. train a control policy without complex reward designs.

CONTROLLER OVERVIEW



OUR APPROACH

- CONDITIONING DISCRIMINATOR



- s_t : State of a character
- D_t: Prediction whether fake/real
- c_t : Predicted motion class

- REWARD DESIGNS FOR POLICY

We train a control policy with a reward function that is designed using outputs from the discriminator.

$$r(s_t, a_t) = w^S r^S + w^C r^C = f(D_t) + g(c_t, \hat{c}_t)$$

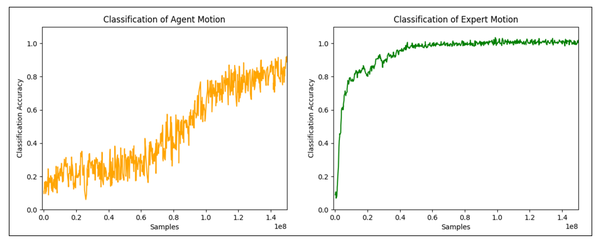
r^S : Style reward (Motion quality)
r^C : Control reward (User Control)

CHALLENGES

- **Sample Efficiency**
  More kinds of motor skills require more samples and training times.
- **Motion transition**
  Lack of transition motion references between motor skills.
- **Degradation of motion quality**
  Overall motion quality got degraded when the motion space characters should learn increases.

RESULTS

Our discriminator has an auxiliary classifier which classifies input motions into several motion classes.
It is intended to predict user intentions from given motions.
As our character gradually learns motions in detail, our discriminator classifies the type of character's motions well.



Classification accuracy for Agent's behaviors
Classification accuracy for Real data (motion capture)

REFERENCES

[1] Jonathan Ho and Stefano Ermon. 2016. Generative adversarial imitation learning. Advances in neural information processing systems 29 (2016).
[2] Augustus Odena, Christopher Olah, and Jonathon Shlens. 2017. Conditional image synthesis with auxiliary classifier gans. In International conference on machine learning. PMLR, 2642–2651.
[3] Xue Bin Peng, Ze Ma, Pieter Abbeel, Sergey Levine, and Angjoo Kanazawa. 2021. Amp: Adversarial motion priors for stylized physics-based character control. ACM Transactions on Graphics (TOG) 40, 4 (2021), 1–20.