SIM2REAL TRANSFER OF DEEP REINFORCEMENT LEARNING POLICIES IN A HUMANOID ROBOT

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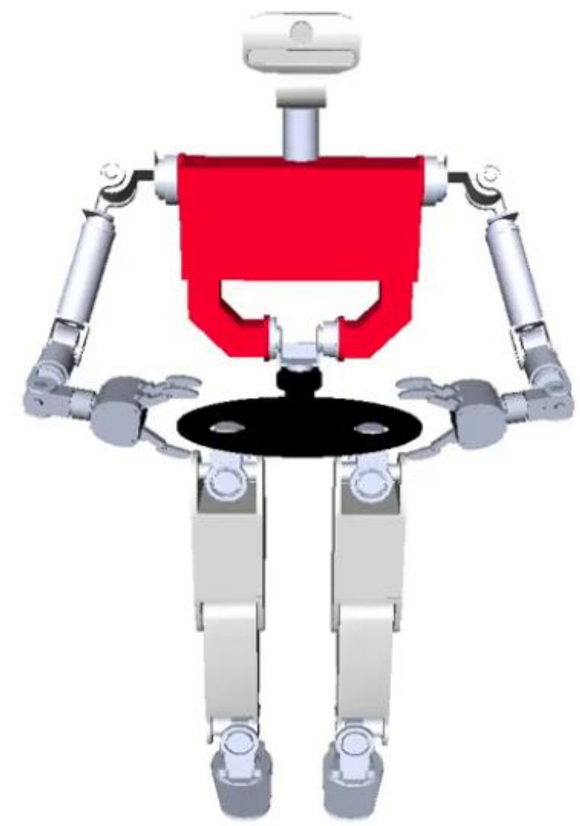
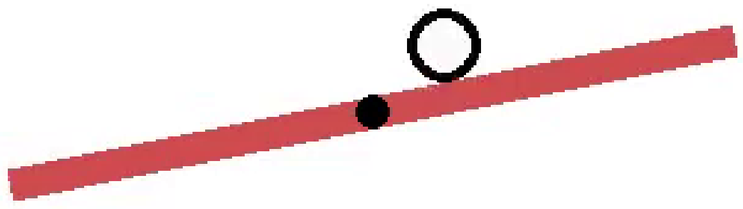
BACKGROUND

Simulated environments provide an excellent means for developing and testing control algorithms aimed at robots with several degrees of freedom. This is equally valid wrt. the training stage of deep neural networks in the context of applying reinforcement learning techniques. However, any result thus obtained will be subject to deviating from the real-world behavior as a side-effect of the simulator itself.

Main goal: fill the "gap" between simulation and reality so that any result obtained on the former can be successfully transferred on the latter.





GYM-MARBLE EXPERIMENTS

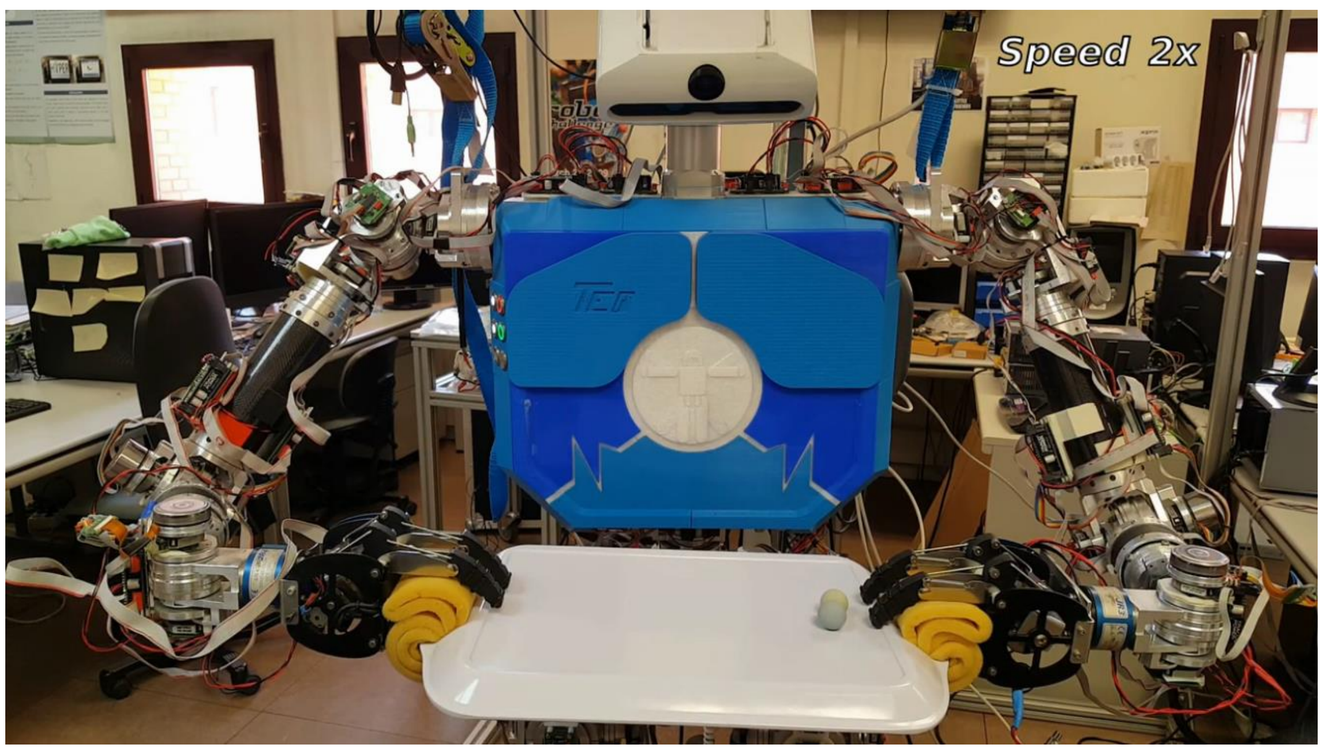
A first attempt on sim2real transfer through a simple toy environment using the OpenAI Gym API.

- **Real bi-manipulation task:** TEO holds a tray using both grippers, a marble released on it must stay as close to the tray center point as possible, at all times. Position tracking via RGB camera.
- **Simulated task:** a ball must never fall from a moving plane that revolves around a fulcrum. Both 2D and 3D variants will be considered.

ROADMAP

1. 2D: PyGame (graphics engine) + Box2D (physics engine) **(tested)**
2. 2D (currently implemented): PyGame + custom physics ✓
3. 3D (idea): OSG (graphics) + ODE (physics)
4. 3D: PyBullet as integrated simulation environment

Currently testing: discrete observation space, reward obtained from a Q table.



https://youtu.be/hzQrKVqFxTk

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- ALMA: Human Centric Algebraic Machine Learning, H2020-EIC-FETPROACT-2019
- ROBOASSET: Sistemas robóticos inteligentes de diagnóstico y rehabilitación de terapias de miembro superior, PID2020-113508RB-I00, Agencia Estatal de Investigación (AEI)