

IBRIDO: A Software Ecosystem for Research in Reinforcement Learning-based Receding Horizon Control[§]



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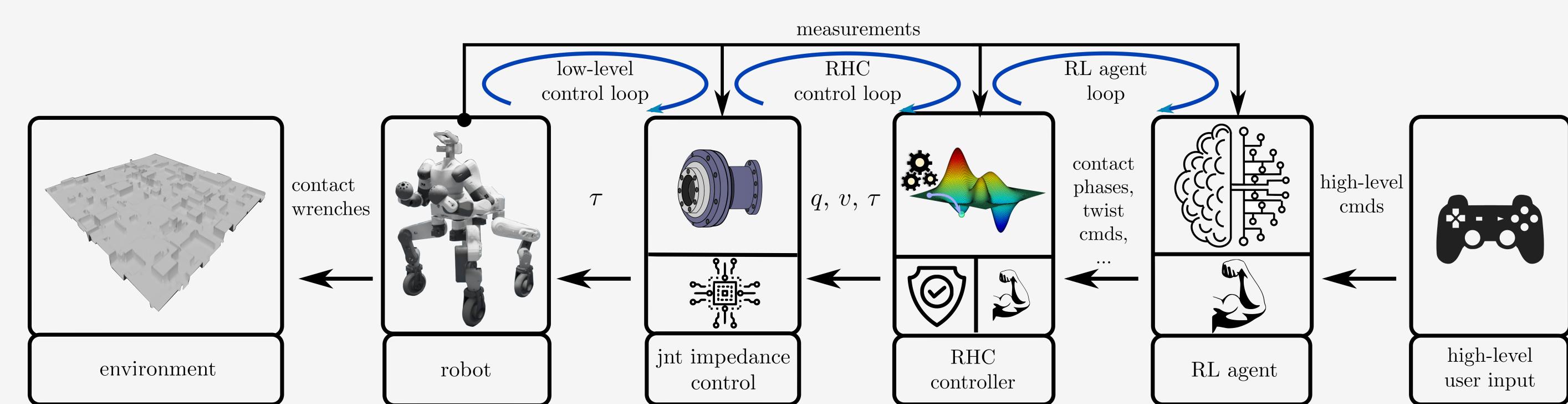
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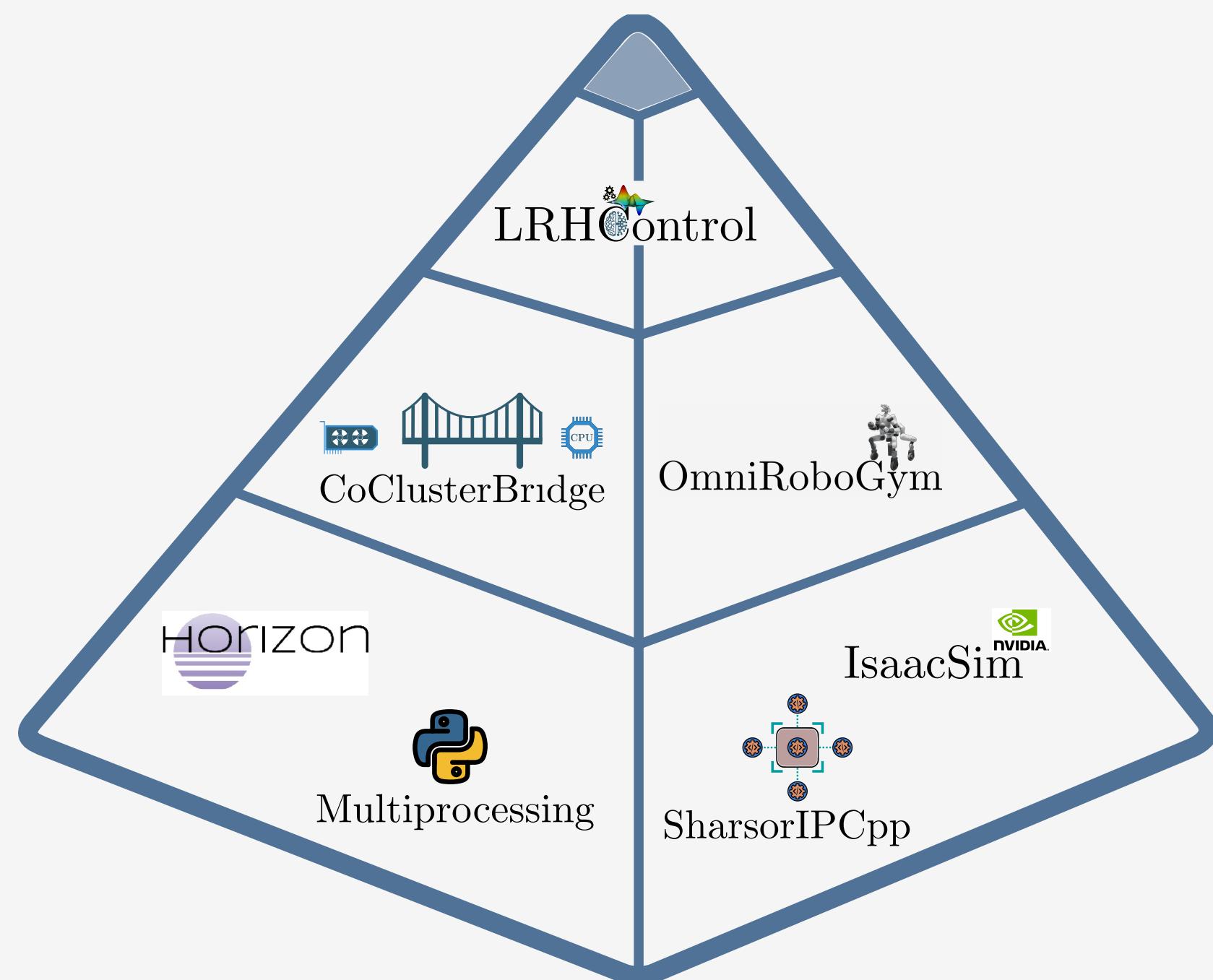
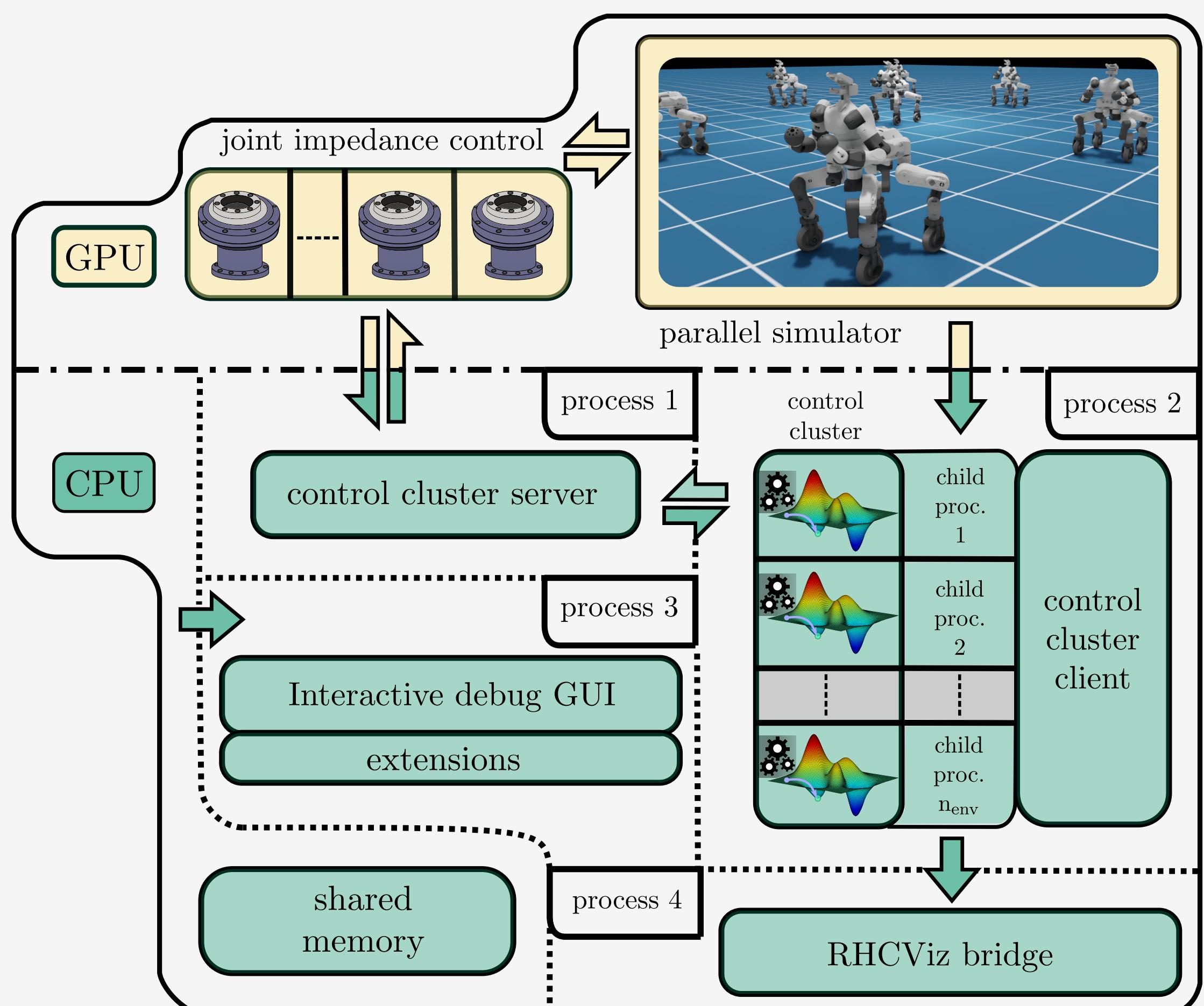
A Hybrid Approach: combining Receding Horizon Control and Reinforcement Learning

Most popular approaches:

- 1) *Model augmentation*: integration of learned models into RHC controllers to improve prediction accuracy and control performance
- 2) *Adaptive tuning and parameter optimization*: RHC parameters tuning (e.g. weights, costs, constraints), based on real-time data
- 3) *Safety*: a learned-policy is coupled with a RHC controller, which in this context takes the role of a *safety filter*



Software architecture

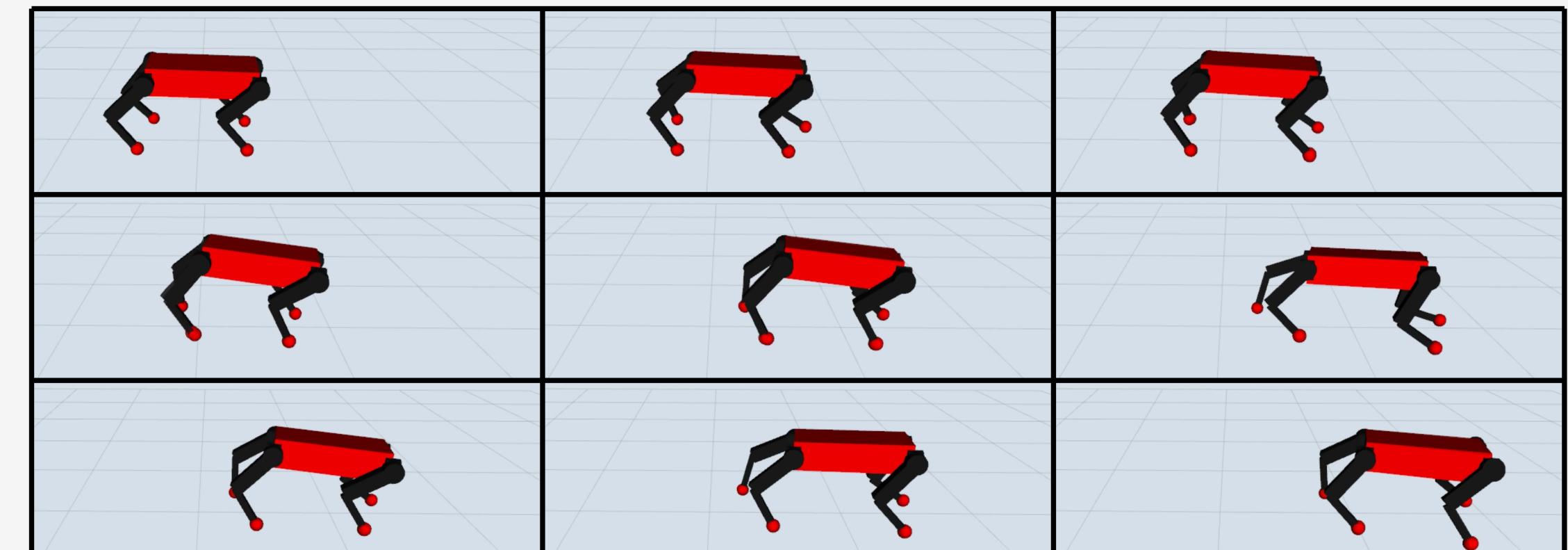


Training env implemented separately wrt simulation environment. One train env step = one cluster step = n simulation steps, depending on the cluster rate. Simulation runs parallel wrt cluster solution (more efficient and realistic). RHC interfaces with robot through a joint impedance controller. A set of debug tools allow to perform easy reward tuning/inspection of the simulator/RHC,etc..

A proof-of-concept example: quadruped walking on flat ground

We designed a proof of concept example to test the use of the framework. Focus on quadruped locomotion, with the RL agent in charge of RHC twist commands + stepping phases selection. Agent exposed to proprioceptive measurements (orientation, meas twist, refs, rhc running cost/ constraint violation, stepping phases). We use a custom implementation of PPO which correctly differentiates between terminations and truncations. RHC developed in HHCM, not open for now. Random walk on flat ground. Twist reference tracking.

A proof-of-concept example: preliminary results



Future directions and challenges

Test of other RL algorithms, namely SAC for improved sample efficiency and exploration. Test on wheeled quadrupeds, full phase control by agent. Real robot deployment.

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Resources and contact information



<https://github.com/AndrePatri/IBRIDO>



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