A Software Ecosystem for Research in Reinforcement Leaning-based Receding Horizon Control[§]

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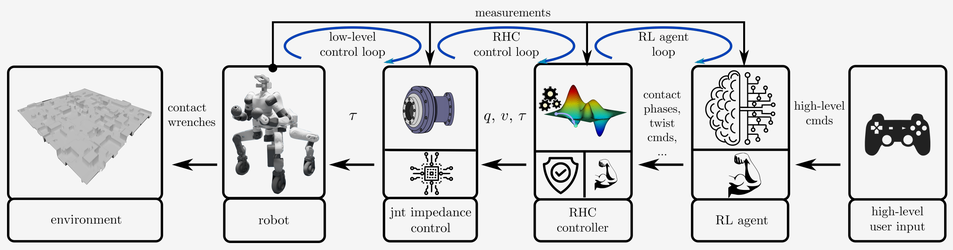
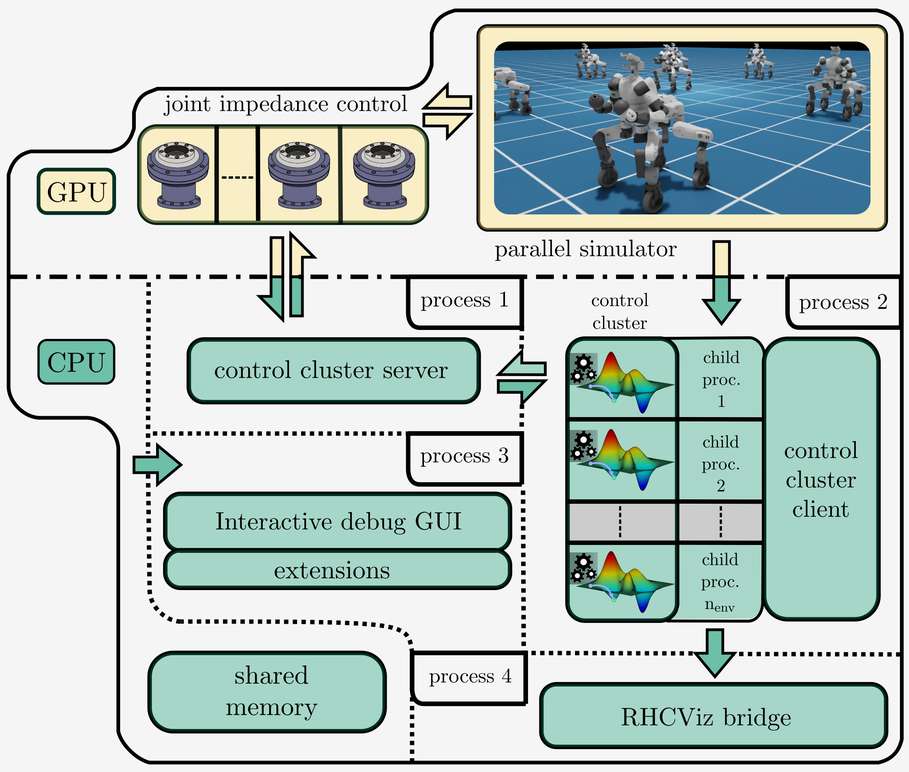
A Hybrid Approach: combining Receding Horizon Control and Reinforcement Learning



Software architecture

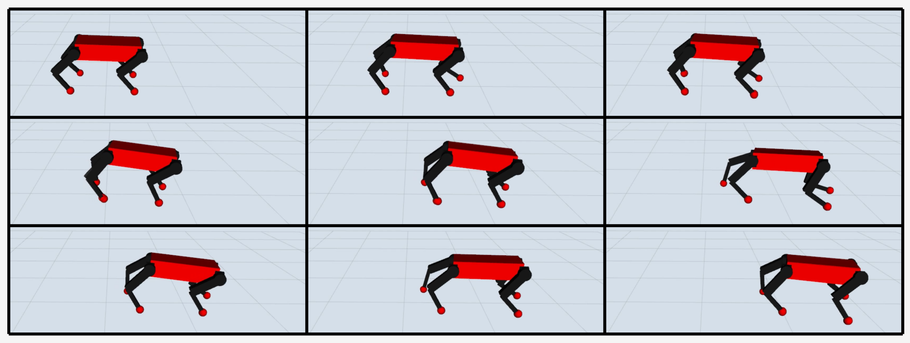


Training env implemented separately wrt simulation environment. One train env step = one cluster step = n simulation steps, depending on the cluster rate. Simulation runs parallel wrt cluster solution (more efficient and realistic). RHC interfaces with robot thorugh a joint impedance controller. A set 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

https://github.com/AndrePatri/LRHControl