Poster Number

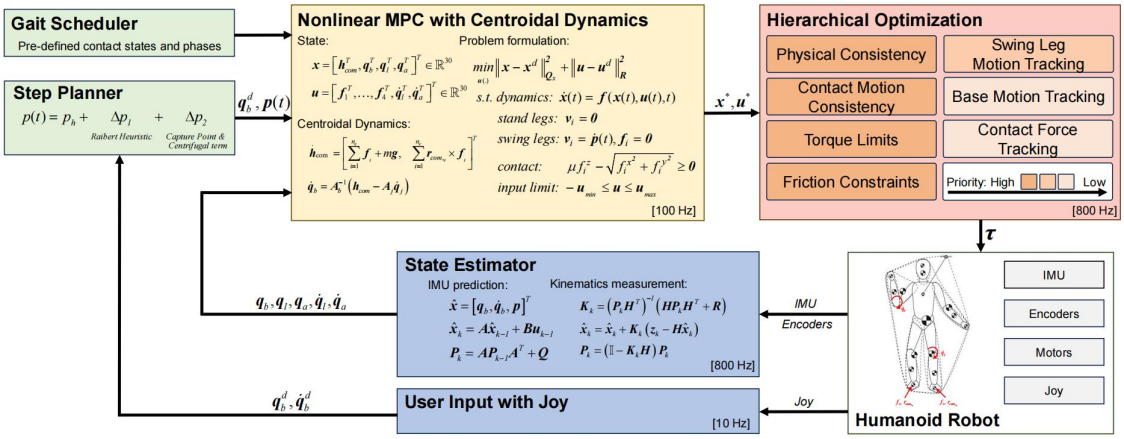
Prioritized Whole-body Control for Humanoid Robots with Centroidal Dynamics

Tianlin Zhang, Linzhu Yue, Hongbo Zhang, Yunhui Liu
Mechanical and Automation Engineering, The Chinese University of Hong Kong

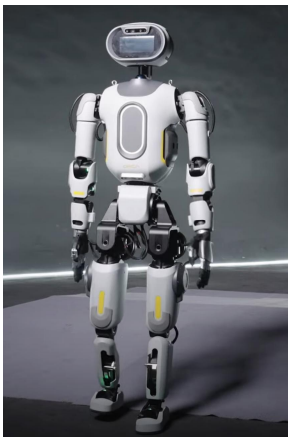
BACKGROUND AND PURPOSE

Humanoid robots are widely used because their limbs allow them to perform a variety of tasks. However, the heavy limbs can change the distribution of the robot's mass and inertia during movement, leading to instability. This paper presents a prioritized whole-body controller for humanoid robots. The controller uses centroidal dynamics to consider the effect of the limb's motion and applies hierarchical optimization to prioritize tracking limb motions, which helps eliminate the uncertainty caused by the limb's motion. Experimental results show that the proposed controller can maintain stability at walking speeds up to 1 m/s and under a 30N external disturbance while enabling natural, coordinated limb movements.

METHODS



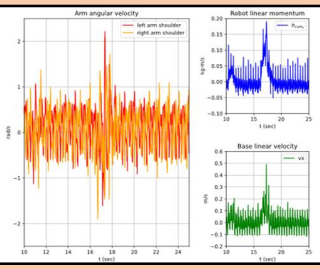
Control framework diagram



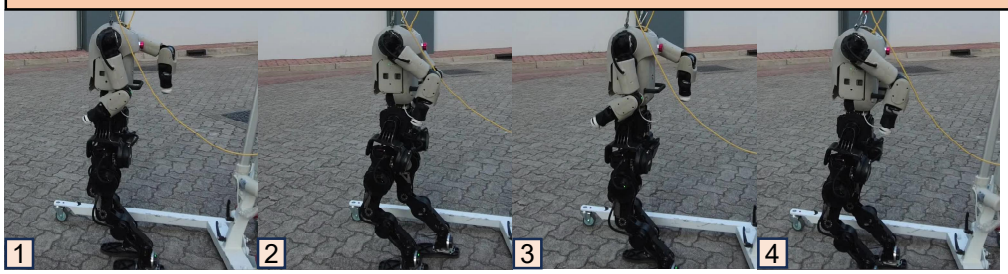
Orca humanoid robot

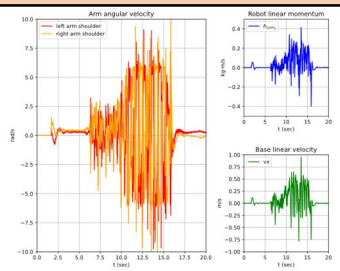
RESULTS

Disturbance



Walk





All experiments run on the user's computer (Intel(R) Core(TM) i7-13650HX@2.60GHz). The NMPC is solved by OCS2[1] and the hierarchical optimization is solved by QPOASES[2].

References:

[1] Farbod Farshidian, Michael Neunert, Alexander W Winkler, Gonzalo Rey, and Jonas Buchli. An efficient optimal planning and control framework for quadrupedal locomotion. In 2017 IEEE International Conference on Robotics and Automation (ICRA), 93–100. IEEE, 2017.

[2] H. J. Ferreau, C. Kirches, A. Potschka, H. G. Bock, and M. Diehl, qpoases: A parametric active-set algorithm for quadratic programming, Mathematical Programming Computation, vol. 6, pp. 327–363, 2014.

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