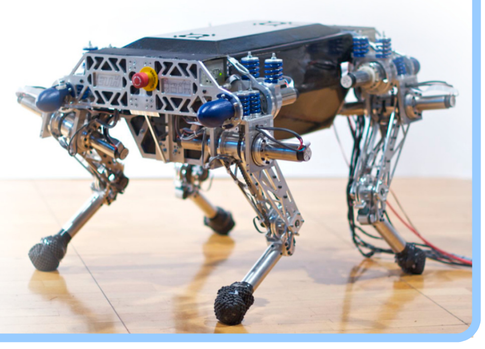
Autonomous Systems Lab ETH zürich

Disney Research

Towards Dynamic Walking for StarlETH

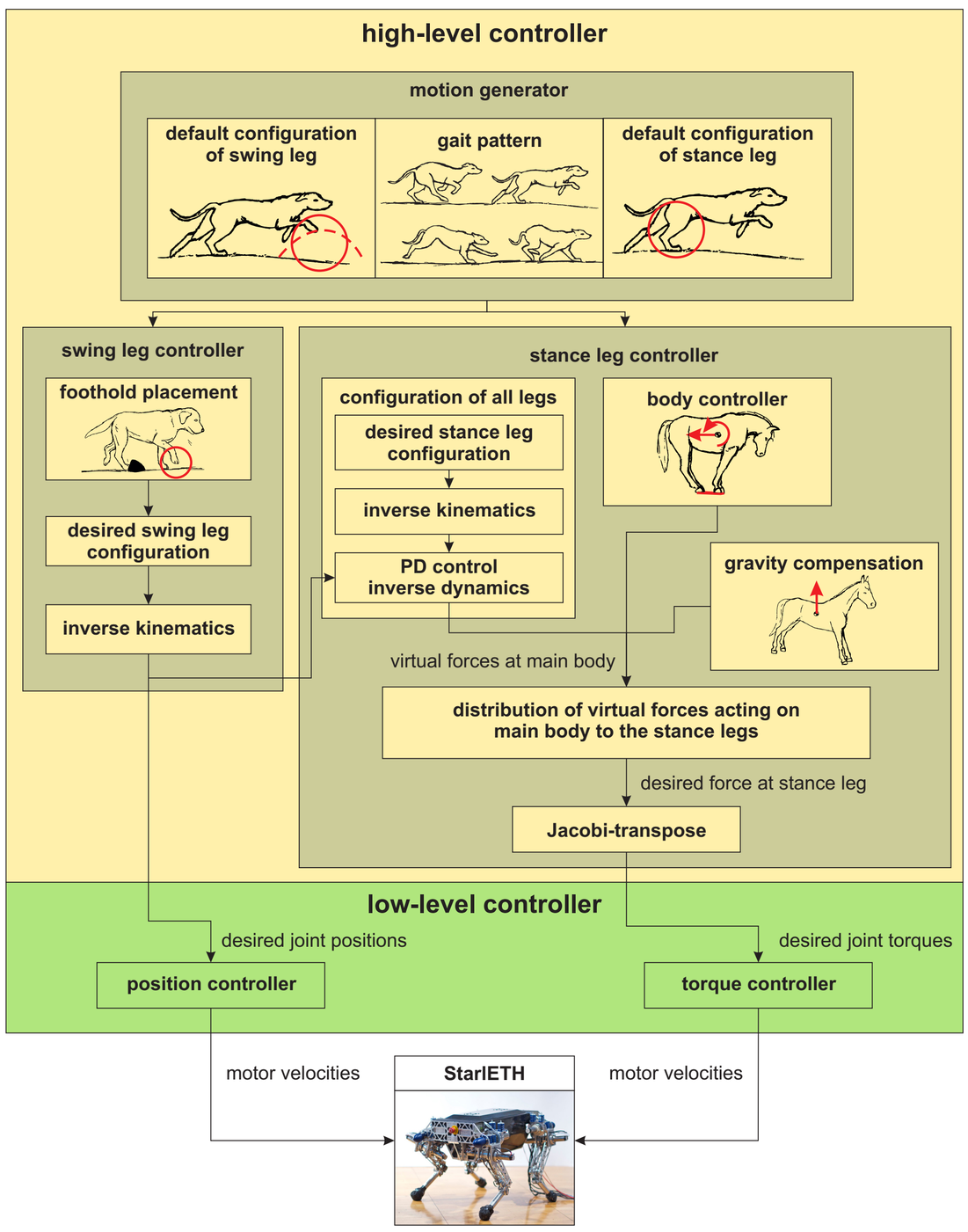
Motivation

- Increase repertoire of motions for StarlETH (Springy Tetrapod with Articulated Robotic Legs), a highly compliant quadruped with series-elastic actuation [1].
- Life-like dynamic gaits such as trotting, bounding and galloping.
- Robust to external disturbances such as terrain variations, pushes, etc.



Control Design

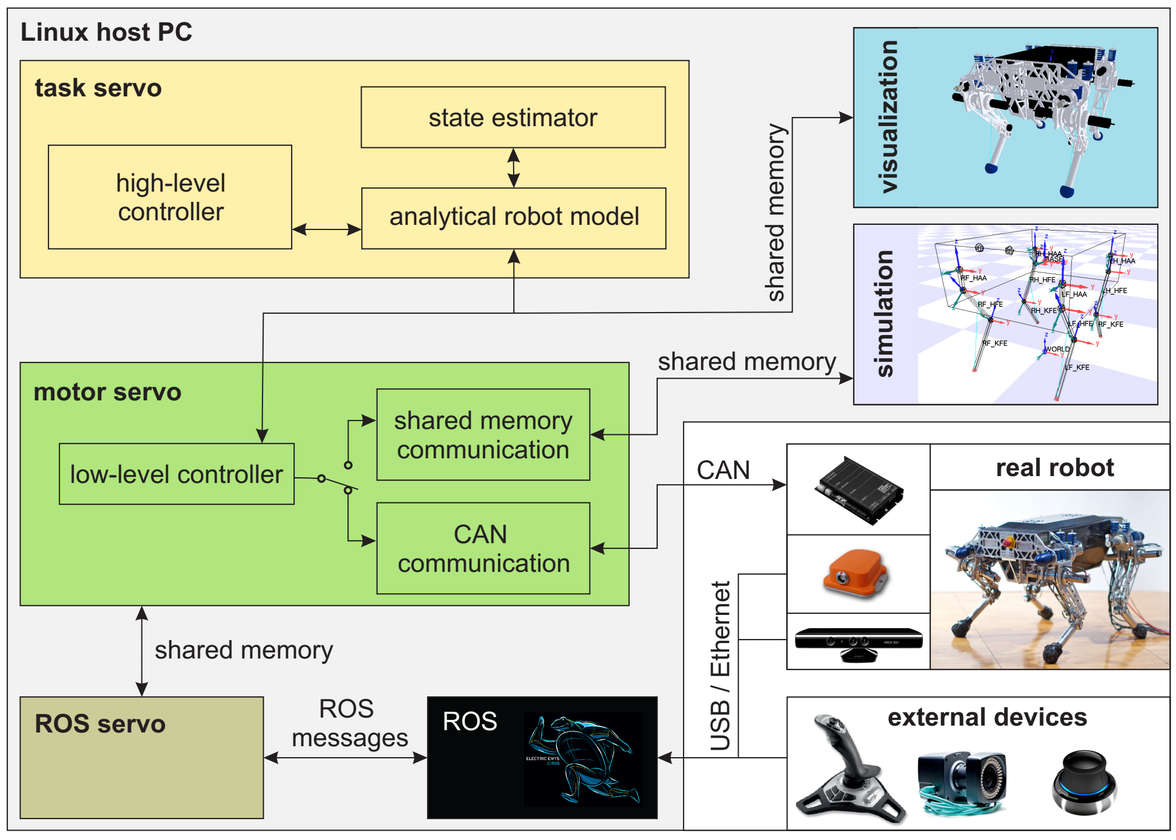
- The control strategy in [2] successfully demonstrated fast gaits with unplanned interactions in simulations.
- The controller combines simple building blocks:



- Some alterations were necessary to make it run on StarlETH:
  - Position control during swing phase instead of torque control due to the ability of the robotic platform
  - Improved force distribution to stance legs

Software Architecture

- The real-time control and simulation software package SL [3] runs on an off-board Linux Host PC:



- The commands are transmitted on four CAN buses.
- The update rates of the controllers are 400 Hz.
- The model-based controller is independent of the robot model that is used in simulation.
- Sensor noise and state estimation can be simulated to test robustness.

Results

- Static walking works both in simulation and on real robot
- Some problems:
  - Strong vibrations during touch-down and lift-off
  - Controller parameters behave differently in simulation and in real-world
- In the near future:
  - Improve accuracy of the robot model to investigate sources of errors (e.g. appropriate model of actuation unit)
- Demos available: http://www.leggedrobotics.ethz.ch

Discussion

- How can we evaluate the significance of modelling errors and their effects on the controller robustness?
- How significant are simulation results for a control algorithm that is evaluated independent of a robotic platform?

References

[1] M. Hutter, C. Gehring, M. Bloesch, M. H. Hoepinger, C. D. Remy, , and R. Siegwart. Starleth: A compliant quadruped for fast, efficient, and versatile locomotion. CLAWAR, 2012.
[2] S. Coros, A. Karpathy, B. Jones, L. Reveret, and M. van de Panne. Locomotion skills for simulated quadrupeds. ACM Transactions on Graphics, 30(4): Article TBD, 2011.
[3] S. Schaal. The SL simulation and real-time control software package. 2006.

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