State Estimation for Legged Robots

Keywords

State Estimation, Observability, Perception, SLAM, Sensor Fusion, Extended Kalman Filtering.

1 Description

The Dynamic Legged Systems Lab (DLS) is currently working on the implementation of state estimation algorithms for a range of diverse applications for quadruped robots. Some examples include probabilistic foot contact estimation [1] and hetrogeneous sensor fusion for accurate state estimation [2]. Our hydraulic quadruped robot series - HyQ - is a fully torque-controlled system, capable of locomotion over rough terrain and performing highly dynamic tasks such as jumping and running with a variety of gaits. It is a unique research platform, designed for unstructured environments.

We are currently looking for a highly motivated, full-time internship position to work on the implementation, evaluation, and further development of state estimation algorithms into our legged robot framework.
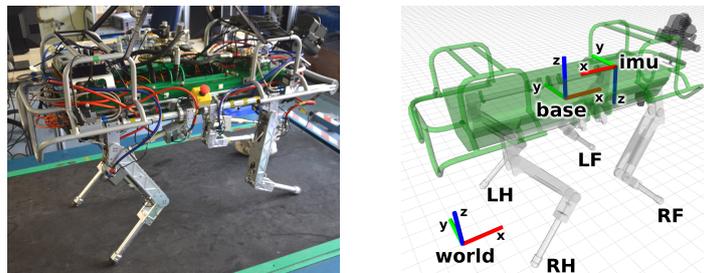

Figure 1: IIT's Hydraulic Quadruped Robot (HyQ).

2 Tasks

- Analyze the observability of legged robots with different sensor modalities.
- Implement current state estimation and sensor fusion algorithms in order to increase computation efficiency, code readability and re-usability.
- Explore ways to improve the accuracy and robustness of current algorithms.
- Experimental verification.

3 Requirements

At the moment of application, the candidate must have earned at least a bachelor degree in computer science, systems and control, robotics, mechanical engineering, electrical engineering, or related.

Further requirements include:

- Strong programming skills in C++ and Python
- Knowledge of Control theory, Kalman Filtering, and related estimation techniques
- Strong communication skills (written and spoken) in the English language
- Strong team player
- Willingness to integrate into a multidisciplinary, dynamic, international research group
- Knowledge about robot kinematics and dynamics, computer vision, and nonlinear control theory is a plus
- Hands-on experience in robotic systems is a big plus
- Programming skills in Matlab/Simulink is a plus

4 Duration

Minimum 6 months, with the possibility of extension depending on achieved results.

5 How to apply

To apply send an e-mail including your detailed CV, university transcripts and cover letter outlining motivation, experience and qualifications for the position to **geoff.fink@iit.it** stating "[Intern19] State Estimation Position" in the subject of the e-mail.

References

[1] M. Camurri, M. Fallon, S. Bazeille, A. Radulescu, V. Barasuol, D. G. Caldwell, and C. Semini, "Probabilistic contact estimation and impact detection for state estimation of quadruped robots," *IEEE Robotics and Automation Letters*, vol. 2, pp. 1023–1030, April 2017.

[2] S. Nobili, M. Camurri, V. Barasuol, M. Focchi, D. G. Caldwell, C. Semini, and M. Fallon, "Heterogeneous sensor fusion for accurate state estimation of dynamic legged robots," in *Robotics: Science and Systems XIII, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA, July 12-16, 2017*, 2017.