PhD in Electric, Electronics and Communications Engineering

Research Title: Computer Vision for Legged Robots

Funded by
Istituto Italiano di Tecnologia

Supervisor
Geoff Fink (geoff.fink@iit.it)
Claudio Semini (claudio.semini@iit.it)
Alessandro Rizzo (alessandro.rizzo@polito.it)
Giovanni Muscolo (giovanni.muscolo@polito.it)

Contact
Dynamic Legged Systems Lab (https://dls.iit.it)

Context of the research activity
The Dynamic Legged Systems Lab (DLS) is a state of the art research centre in the Advanced Robotics department of the Istituto Italiano di Tecnologia (IIT). DLS is currently working on the implementation of computer vision algorithms for a range of diverse applications for quadruped robots (stair climbing, terrain mapping, obstacle avoidance, visual servoing, automatic sensor calibration, state estimation, among others). 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.

Autonomous legged robots are required to handle a wide range of tasks in complex environments. Current computer vision algorithms are not robust in dynamic environments, however, using computer vision is critical to improving autonomy. It is well known that video images provide rich information about the environment which is critical for localization in environments without a priori maps. For example, such uncertainty in environment would be expected in monitoring a disaster scene.
### Objectives

The main research objectives of this PhD thesis includes (not necessarily all):

- Analyze the observability of legged robots with different sensor modalities
- Explore ways to improve autonomy using visual servoing, obstacle avoidance, and SLAM
- Explore ways to improve state estimation using computer vision algorithms and sensor fusion
- Explore ways to improve the accuracy and robustness of current algorithms
- Design algorithms in order to increase computation efficiency, code readability and reusability
- Experimental verification

### Skills and competencies for the development of the activity

At the moment of application, the candidate must have earned a master degree in computer science, control systems, robotics, mechanical/electrical/computer/mechatronics/electronics engineering and related fields.

Further requirements include:

- Strong programming skills in C++ and Python
- Knowledge of computer vision including multiple view geometry
- 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, visual servoing, SLAM, and control theory
- Hands-on experience in robotic systems is a big plus
- Programming skills in ROS, OpenCV, CUDA, and Matlab/Simulink is a plus