PhD meeting

Octavio A. Villarreal Magaña

Istituto Italiano di Tecnologia, Genova, Italy

May 23, 2017

iit ADVR ISTITUTO ITALIANO DI TECNOLOGIA
ADVANCED ROBOTICS

Outline

1. Roadmap for IROS paper (September)
2. Work on max-plus gait generation
3. Overall PhD roadmap
4. Collaboration with Gustavo

Outline

Roadmap for IROS paper

- Total time (considering deadline September 1st): Approximately 12 weeks, taking into account "absence" because of summer schools.
- Max-plus gait generation (without tweaks and hacks) (1.5 weeks)
- Evaluate viability of max-plus generation (1.5 weeks)
- Evaluate sensor information to be used (2 weeks)
- Use sensor information to propose set of gait parameters (3 weeks)
- Simulations and experiments (4 weeks)

Max-plus gait generation

- Consider 1 step gait change
- Implement event feedback in simulation
- Design and implement different trajectory generator
- Modulate angular frequency of the movement

Evaluation of viability of max-plus generation

- Run comparison against current method
  - Gait switch
  - Versatility of gait generation
  - Difficulty to be implemented and controlled
  - Flexibility to be included in the framework
- Analyze pros and cons between the two approaches
- (Propose new approach)

Analyse sensor data to be used

- Use of proprioceptive information (?)
- Only focus on (limited) visual information
- Define the specific visual (type of image, resolution) and proprioceptive sensing to be used during research.

Use of sensor information to propose gait parameters

Possibility of approaches:

- Experimental (simulation) approach: Let the robot run on an specific type of terrain with different sets of parameters and introduce a performance measure to evaluate which set of parameters performed better (preliminary option).

- Analytic: Use the sensor (visual and proprioceptive) information to perform an analysis prior to the robot walking through the terrain and choose the proper set of parameters (similar to the use of the height-map, mapping of sensor information into gait parameters)

Outline

Work on max-plus gait generation

- Current state: The gazebo simulation works the same as in the simulation in python that I previously had

- Further features:
  - Instantaneous (1 step) gait parameter change
  - Problems with touchdown and lift-off event detection
  - Angular frequency modulation

Instantaneous gait change

- Detect legs in swing face

- Use them as the "follow-up" legs for the next gait pattern
  Example: If the current gait is:

$$G_1 = \{1, 4\} \prec \{2, 3\}$$

And we desire to change to:

$$G_2 = \{1\} \prec \{2\} \prec \{3\} \prec \{4\}$$

In the case that legs 2 and 3 are in the air, the gait pattern could be chosen as:

$$G_2^* = \{2\} \prec \{3\} \prec \{1\} \prec \{4\}$$

Problems with touchdown and lift-off detection

- The update works, but sometimes it detects lift-off and touchdown when the feet are not separated from the ground, and the generates weird behaviors

Outline

Overall PhD roadmap

- Implement gait parameter selection based on sensor information
- Introduce terrain learning (vision, no vision)
- Use terrain learning capabilities to overcome various types of terrain (not only gait related)

Outline

Collaboration with Gustavo

- Focus on feedback linearization
- Files where the controller is (not the same for everyone I assume)
- Where to find feedback linearization (design it?)

Thank you. Questions or comments?