

Spring 2018

Home Assignment I

# **Static and Dynamic Locomotion with The Terasic Spider Robot**

Course: Autonomous Robotics

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Video Submissions Link:

<https://drive.google.com/open?id=17Acbd4iQizghHRhOB8PnXzRZh2PmwOeE>

**Objective:**

The objective of this work is to implement a control system for the Spider Robot available in the Smart Embedded Systems Lab. The key design goals are:

1. Implementing a control procedure that will turn the 6-legs robot in a 4-leg robot (the two middle legs up).
2. For the 4-leg configuration, implement a static locomotion and use it to move the robot forward 2 meters.
3. For the 4-leg configuration, implement a dynamic locomotion and use it to move the robot forward 2 meters.
4. With the robot in its original 6-leg configuration, implement static locomotion and move the robot 2 meters.
5. With the robot in its original 6-leg configuration, implement dynamic locomotion and move the robot 2 meters.

**System Overview:**

The Terasic Spider is a six-legged walking robot which is driven with 18 servo motors. These 18 servo motors are controlled by PWM signals generated from Altera DE0-Nano-SoC board embedded inside the Terasic Spider. The FPGA controls the 18 servo motors from the 18 PWM controllers. The Linux Spider program is running on Linux on Altera SoC. The main function of this program is to perform spider movement by the 18 PWM controller on the FPGA side to control the 18 servo motors.

**Locomotion Control Flow:**

Figure 1 shows the stance of our spider robot on four legs. This stance allows the robot to keep the center of gravity always in the middle.

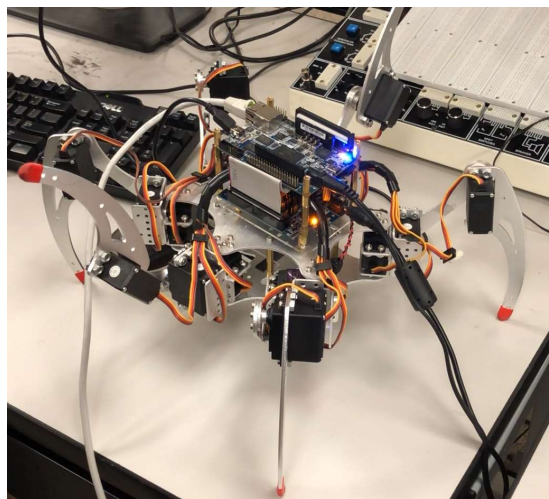


Figure 1: Spider robot standing on 4 legs.

### Timing Analysis:

Table I illustrates the timing analysis data in a tabular form. Go to the provided video link to observe the robot in motion.

| Locomotion Methods | Path coverage time (per 2 meters) |
|--------------------|-----------------------------------|
| 4 Leg Static       | 1.35s                             |
| 4 Leg Dynamic      | 1:02s                             |
| 6 Legs Static      | 0:50s                             |
| 6 Legs Dynamic     | 0:29s                             |

### Discussion

In this work, we have realized a control mechanism for static and dynamic locomotions of the Spider robot. We made the robot move 2 meters to justify the viability of our implementation. The results show that, we achieve maximum speed with six legs dynamic locomotion.