Design and Development of a Planar One-Legged Hopping Robot

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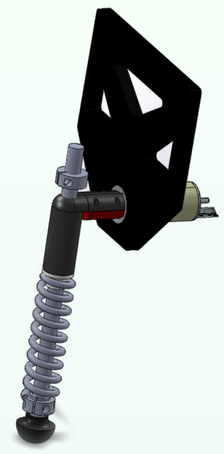
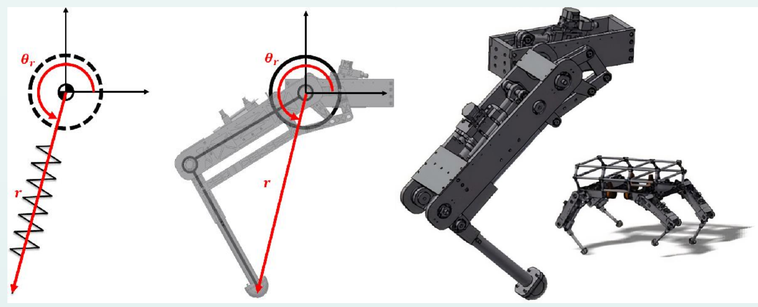


Introduction

Using the legs is the best solution in the robots that are used in rough places. The main reason for this is that wheeled vehicles cannot perform well in rough places. That's why in this project we are modeling the leg of a robot. We take the leg of the animals as an example while making this robot. So, we can think of this robot is modeling the running animal. The running model had been done by using the Spring-Loaded Inverted Pendulum (SLIP) model.

Application Areas

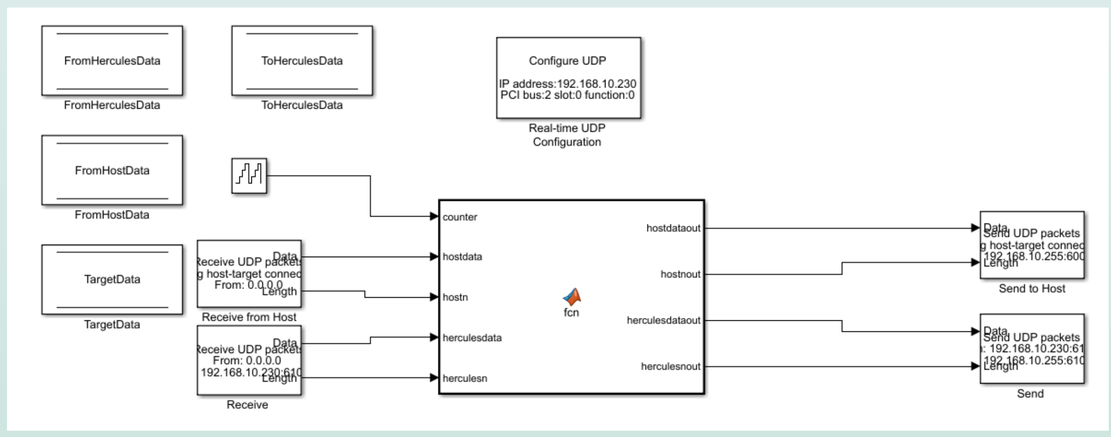
- This project is a research and development project.
- It is very difficult to use a wheeled robot on rough terrain. Therefore, legged robots should be used in these terrains. It is possible to model the movements of these robots with a single-legged robot.



Quadrup robot leg design advanced from basic Slip model

Specifications and Design Requirements

- The estimated model should predict the position and velocity outputs of the robot under 5% and 10%, respectively.
- The robot should be able to track the desired position and velocity targets with less than 5% error. The real time software should work around 1KHz.



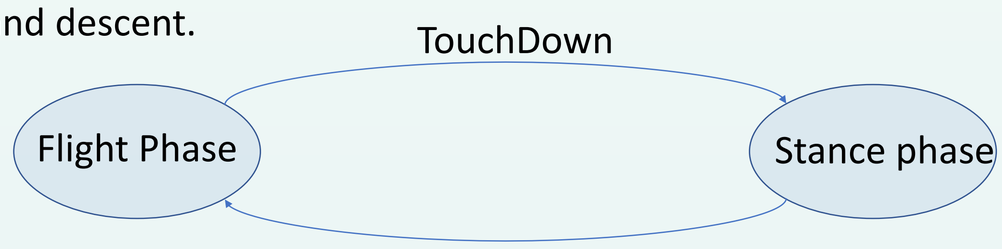
Software Design In Simulink

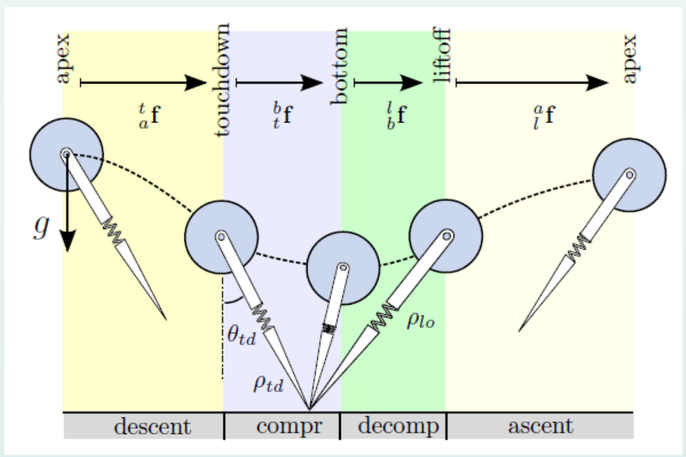
Conclusion

- Modeling the movement and transferring this model to the Matlab environment was one of the most important requirements to realize this system.
- The system, which is modeled and works in real time, transmits the necessary data packets from the Matlab model running on the motherboard to the leg where the movement will occur. The motor driver, on the other hand, starts the movement by controlling the motor.
- This modeled system can pave the way for more advanced robot movements in the future.

Solution Methodology

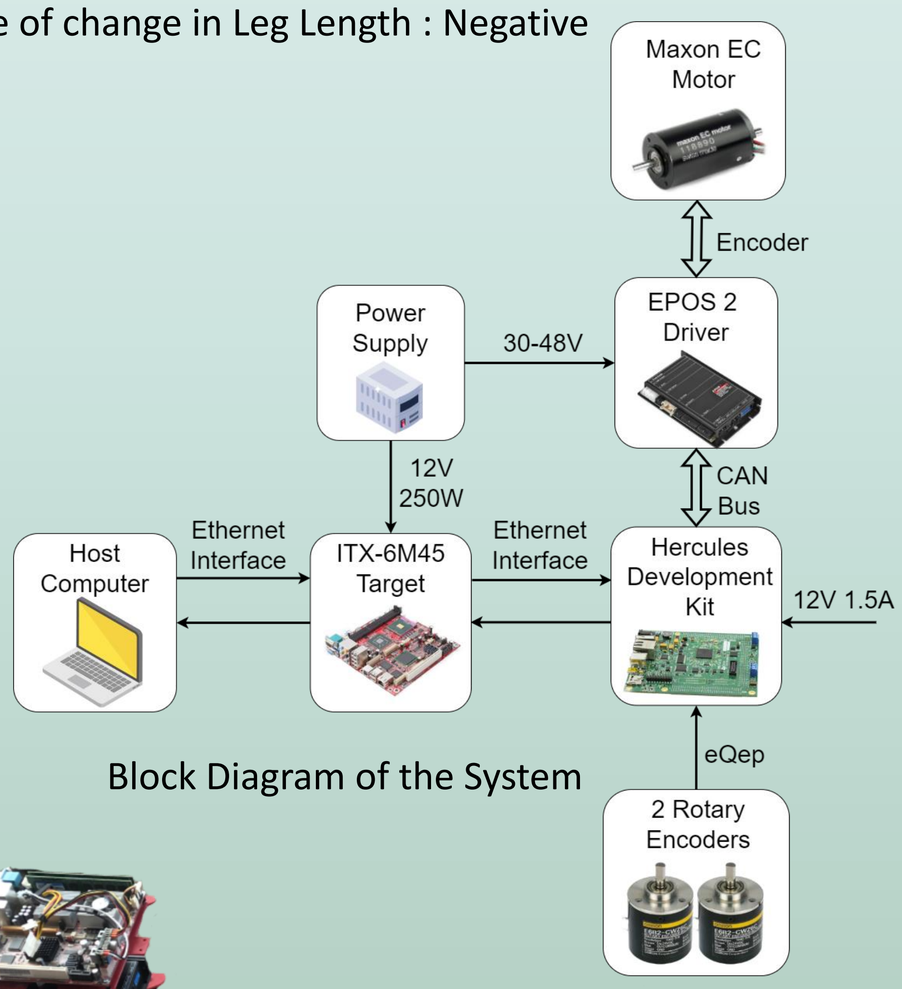
- The SLIP model describes a running animal as the walking motion that occurs when spring pushes a load. For this reason, the SLIP model has been established as an accurate descriptive tool for analyzing dynamic movement in running animals of widely varying sizes.
- There are two sub-states during running; flight and stance. Flight is the moment when the robot has no contact with the ground. Flight state can be examined in two subcases, ascent and descent.





- Ascent: The subperiod when the robot moves upwards.
  Vertical velocity : Positive & Decreasing
- Descent: The subperiod when the robot moves downwards.
  Vertical velocity: Negative & Increasing

- Compression: The spring is compressed and stores energy.
  Rate of change in Leg Length : Positive
- Decompression: The spring is decompressed and releases energy.
  Rate of change in Leg Length : Negative



Block Diagram of the System

Complete design of one legged hopping robot

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