Swing leg control of spring-mass running robots using leg length and leg angle

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1 Motivation

Our motivation comes from running animals negotiating potholes over rough terrain. Ground running birds synchronize their leg length and leg angle such that at the moment of the touch-down, a robust gait is generated.

2 State of the Art

Researchers investigated the behavior of the SLIP model subjected to ground disturbances. In most of the researches, the leg angle and leg stiffness are the parameters to be adjusted for a successful and robust gait [1-3]. The leg peak force in these techniques increases significantly when the steady state running is retained over rough terrain. This problem may cause severe damage to the leg or actuator.

3 Own Approach

In this study we consider the change of the leg length and leg angle and keep the leg stiffness constant. Therefore, the increase in the vertical component of the velocity would be limited, which leads to a much lower leg peak force. The relation between the leg length and leg angle to retain the steady state running is shown in figure 1 for different vertical velocities. The numbers are the leg peak force during the stance.

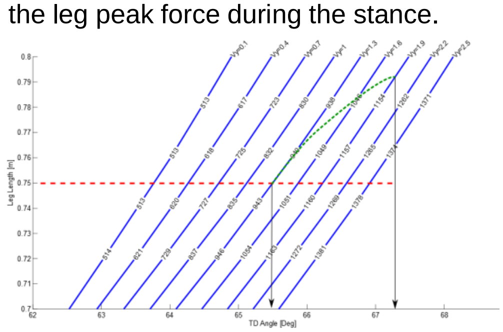

Figure 1: Leg length vs leg angle for equilibrium gait policy.

4 Current Results

The implementation of the control policies show that the leg length can help limiting the leg peak force. The steady state running is retained in the presence of the drop.

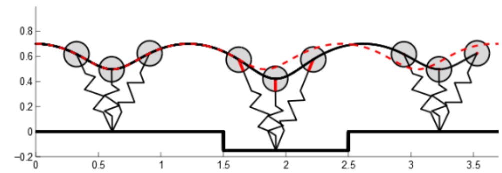

Figure 2: The CoM trajectory of the SLIP model when using the leg length and leg angle.

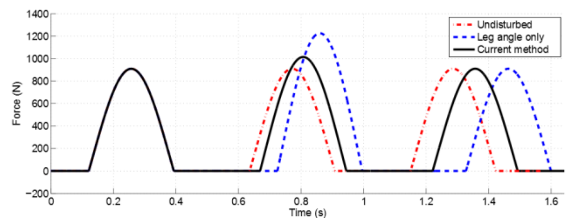

Figure 3: The axial leg force profiles of the SLIP model in the cases of undisturbed, leg angle and the current method.

5 Best Possible Outcome

The system does not experience any increase in the axial peak force during the drop step while it keeps the steady state running. It means the robot is able to move along the contour lines in figure 1.

Acknowledgement

This work is supported by DARPA (W91CRB11-1-0002).

References

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