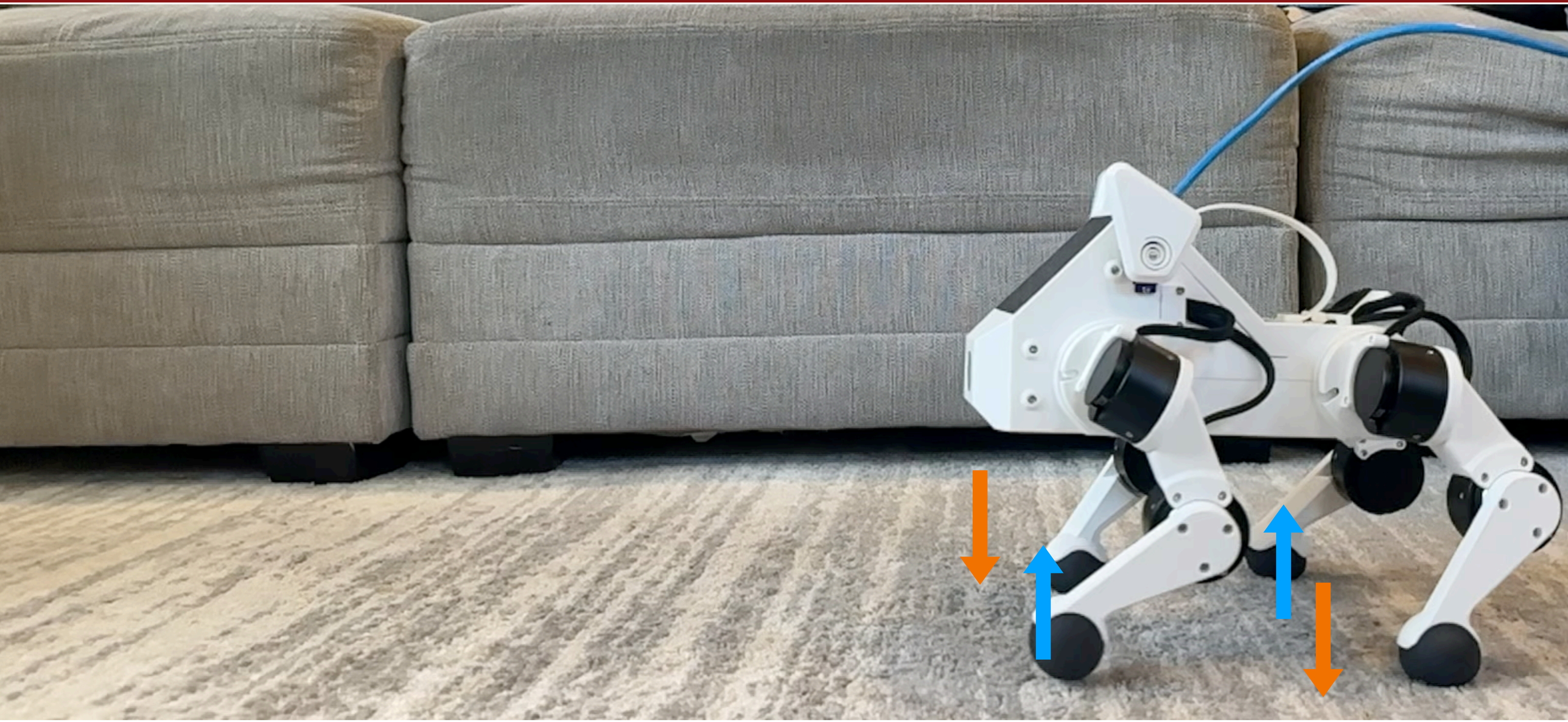
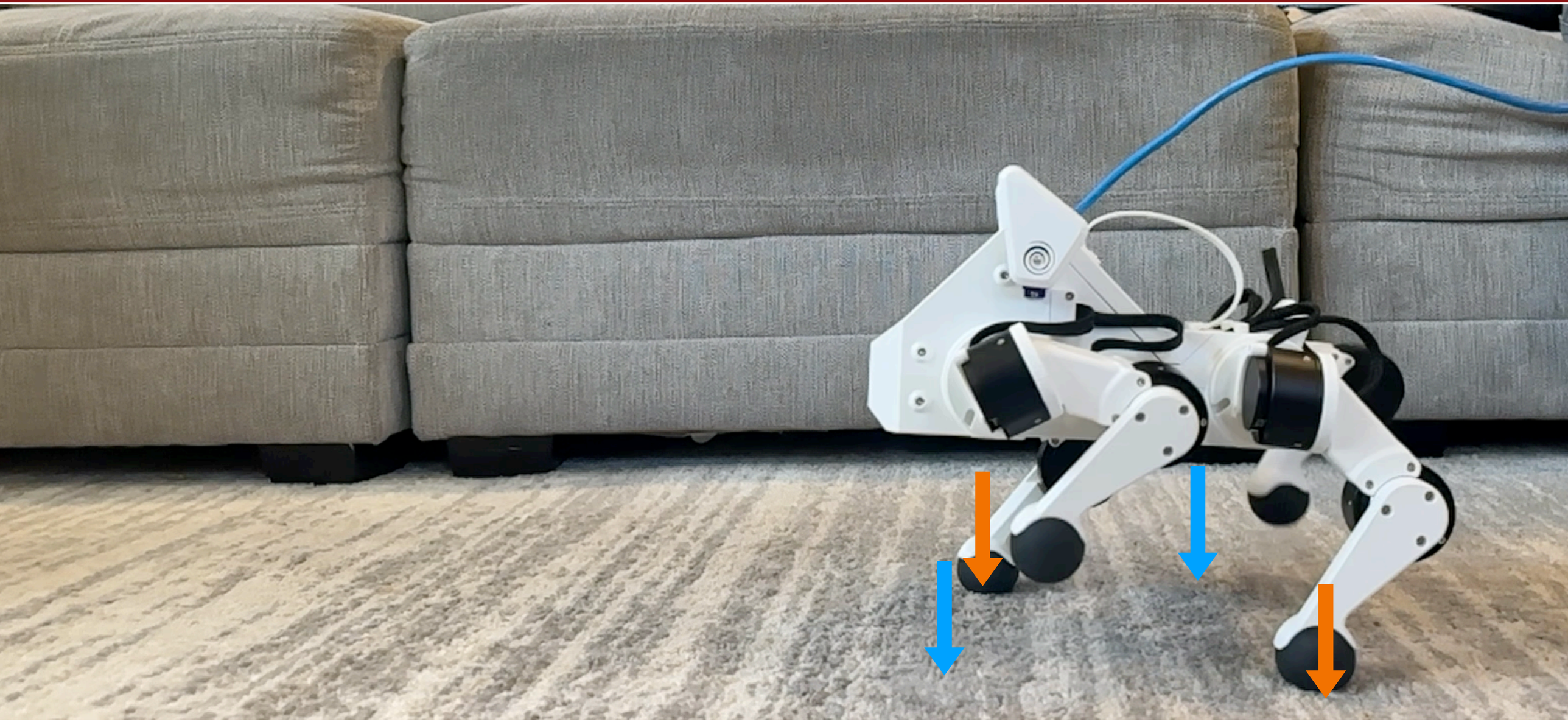
CS123: Gait Control

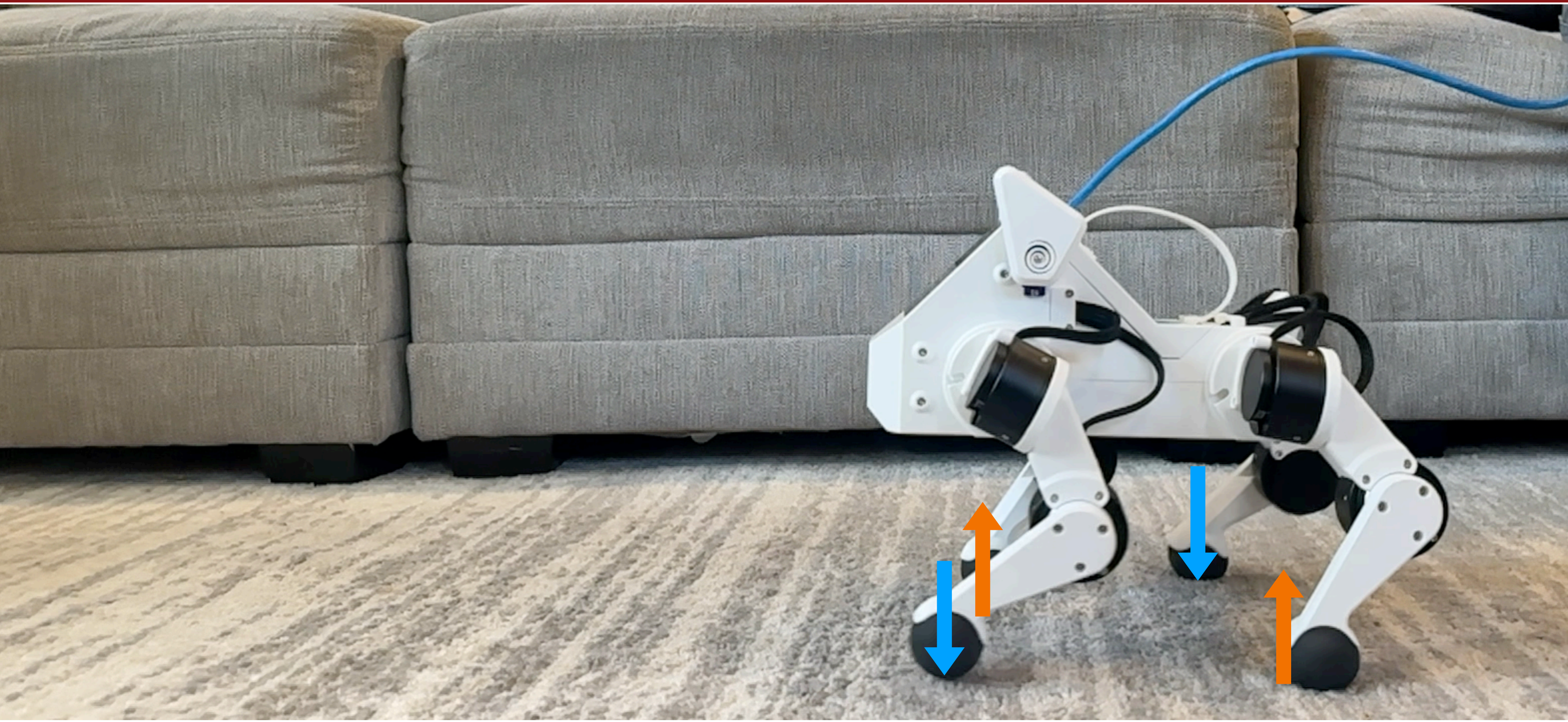
Baseline Heuristic Controller

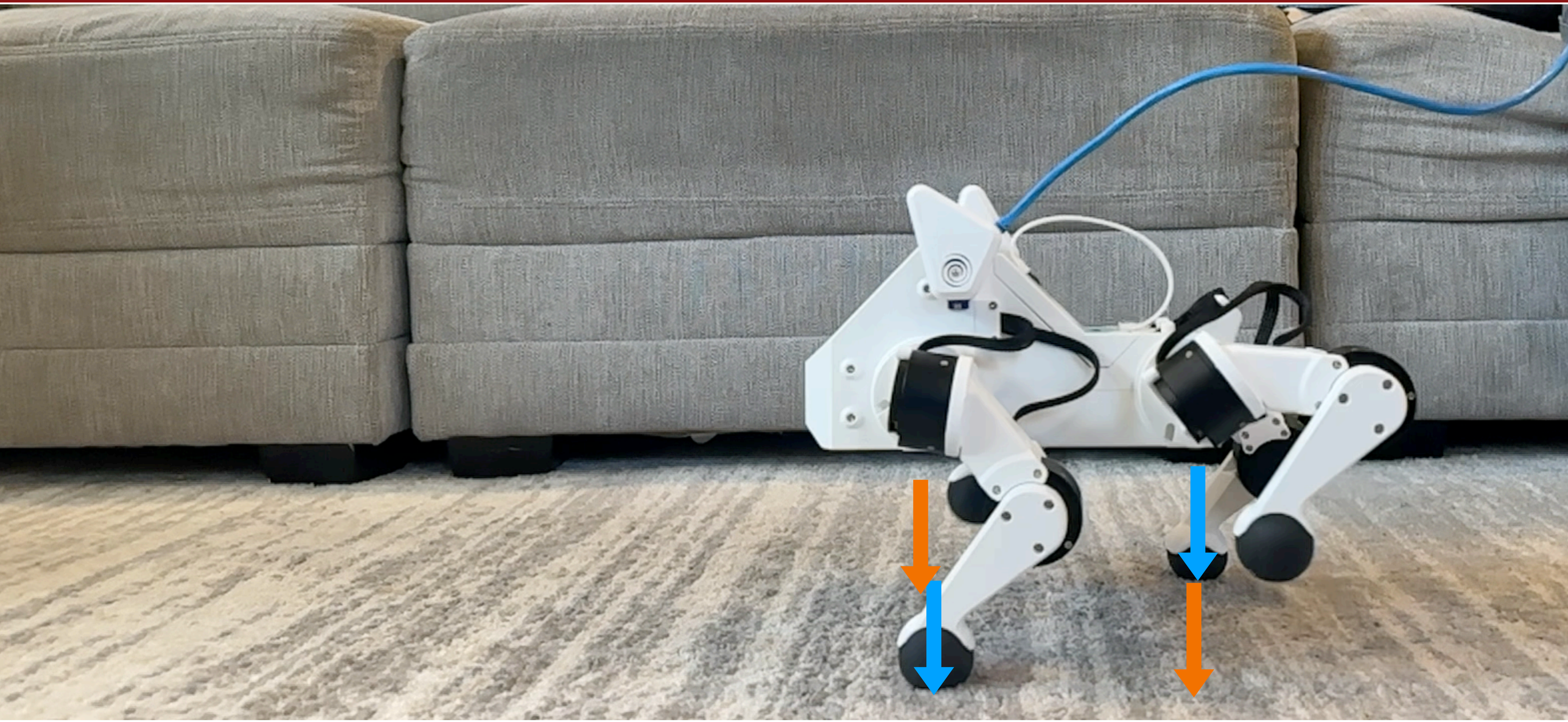
Tingnan Zhang (slides modified from Stuart Bowers original version), Oct 2024

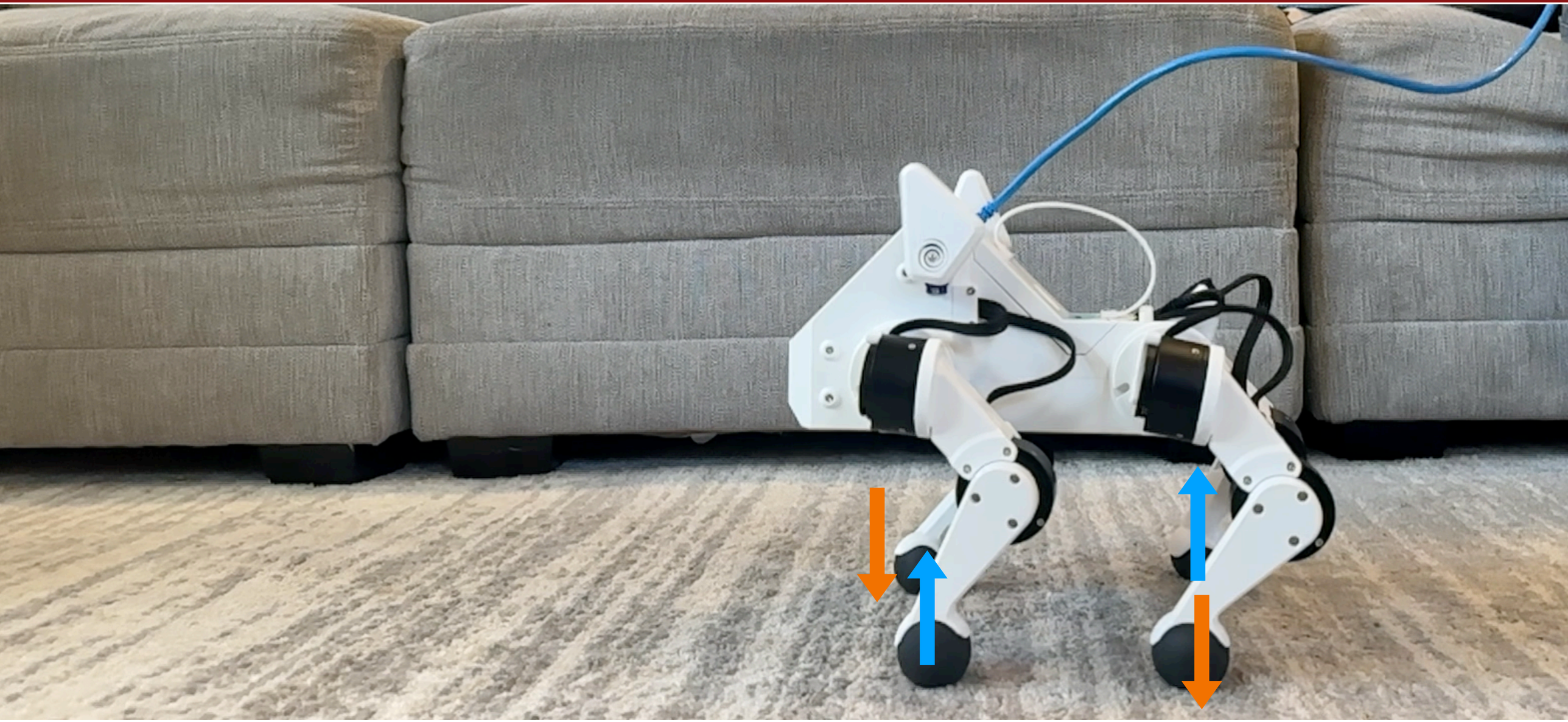

BBC











Coordination

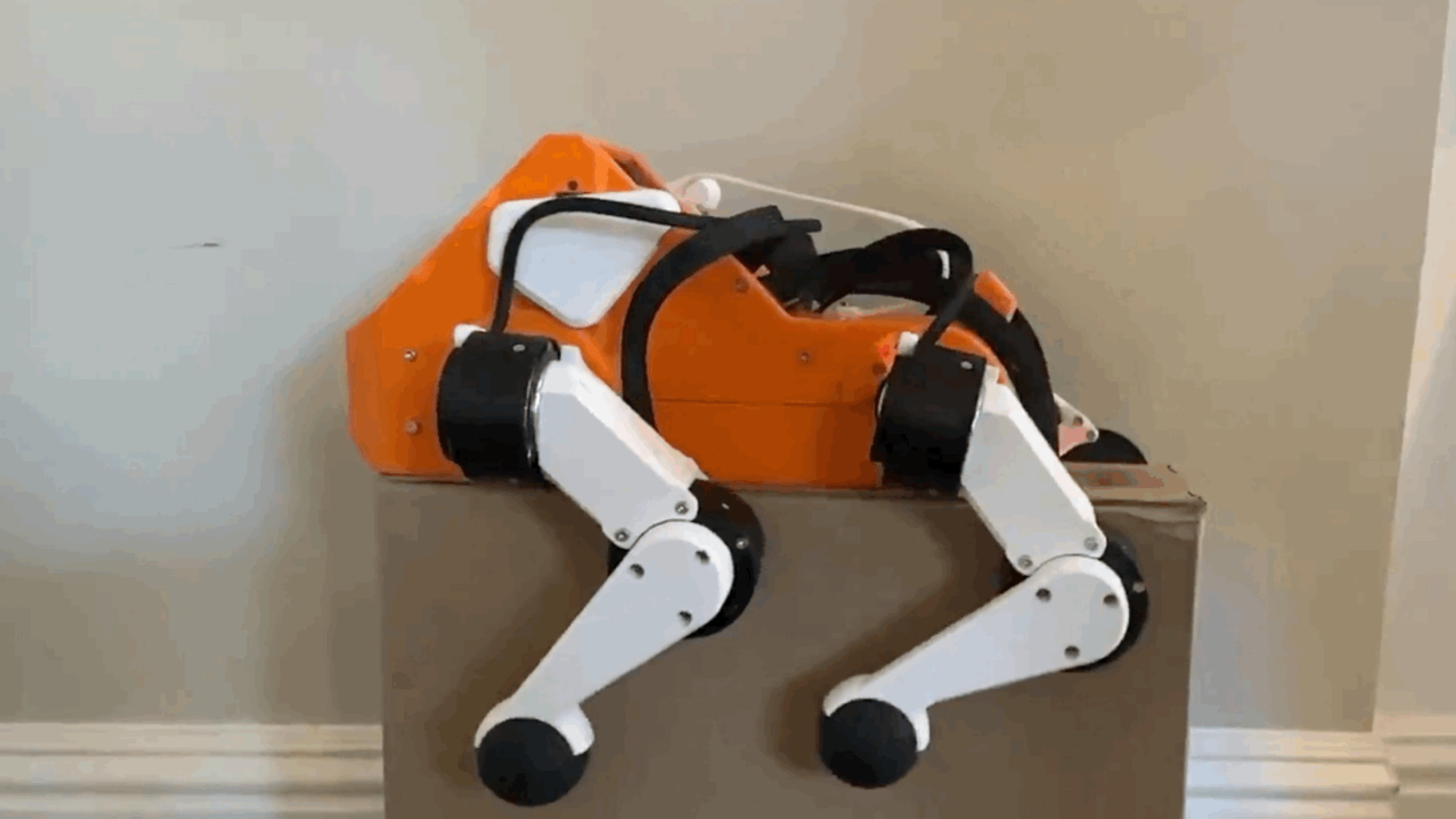
Takeaway: Feet are grouped into sets of two. Each group consists of an opposing front and rear leg that move together.

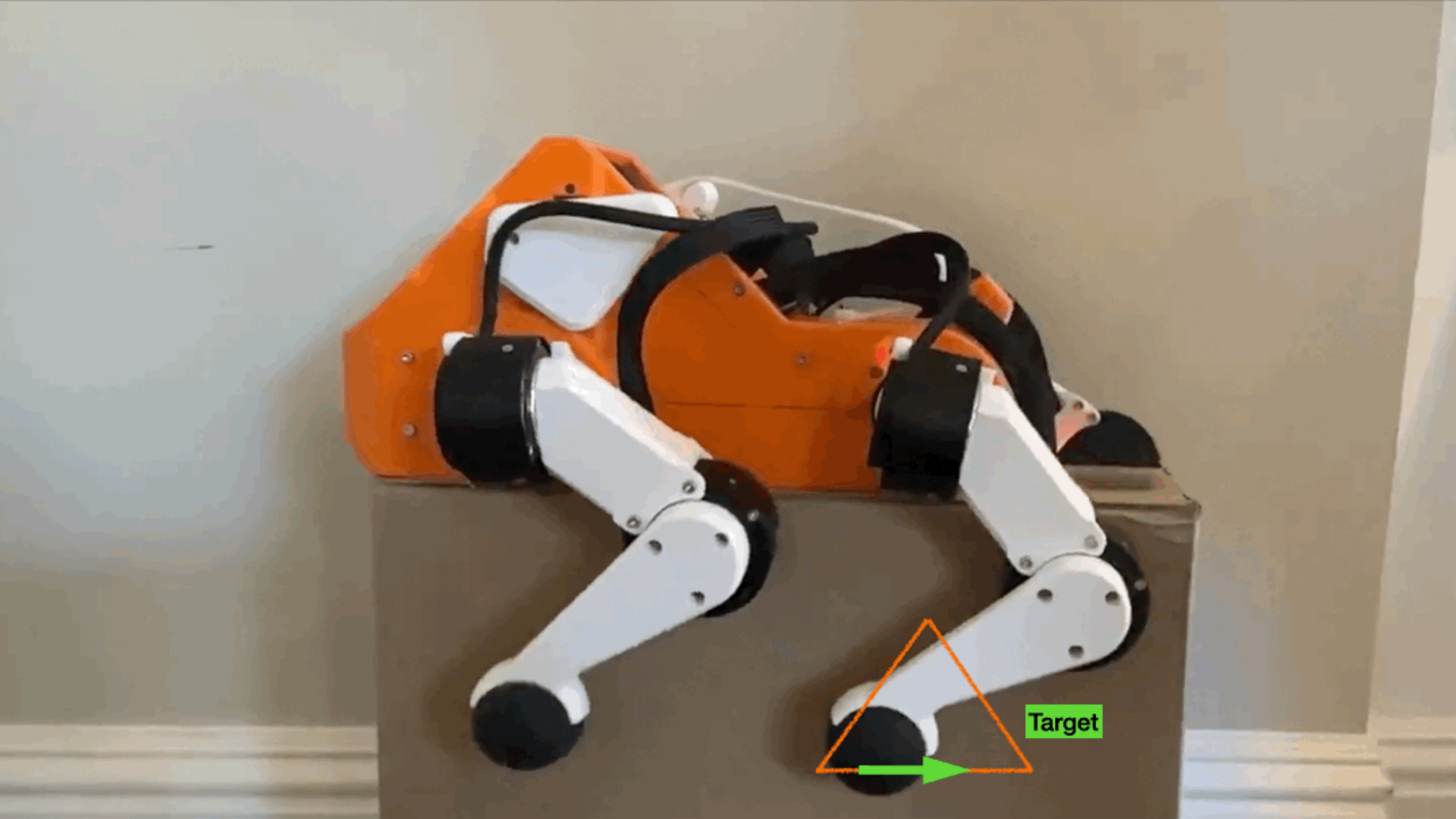
Front Right							
Front Left							
Rear Right							
Rear Left							

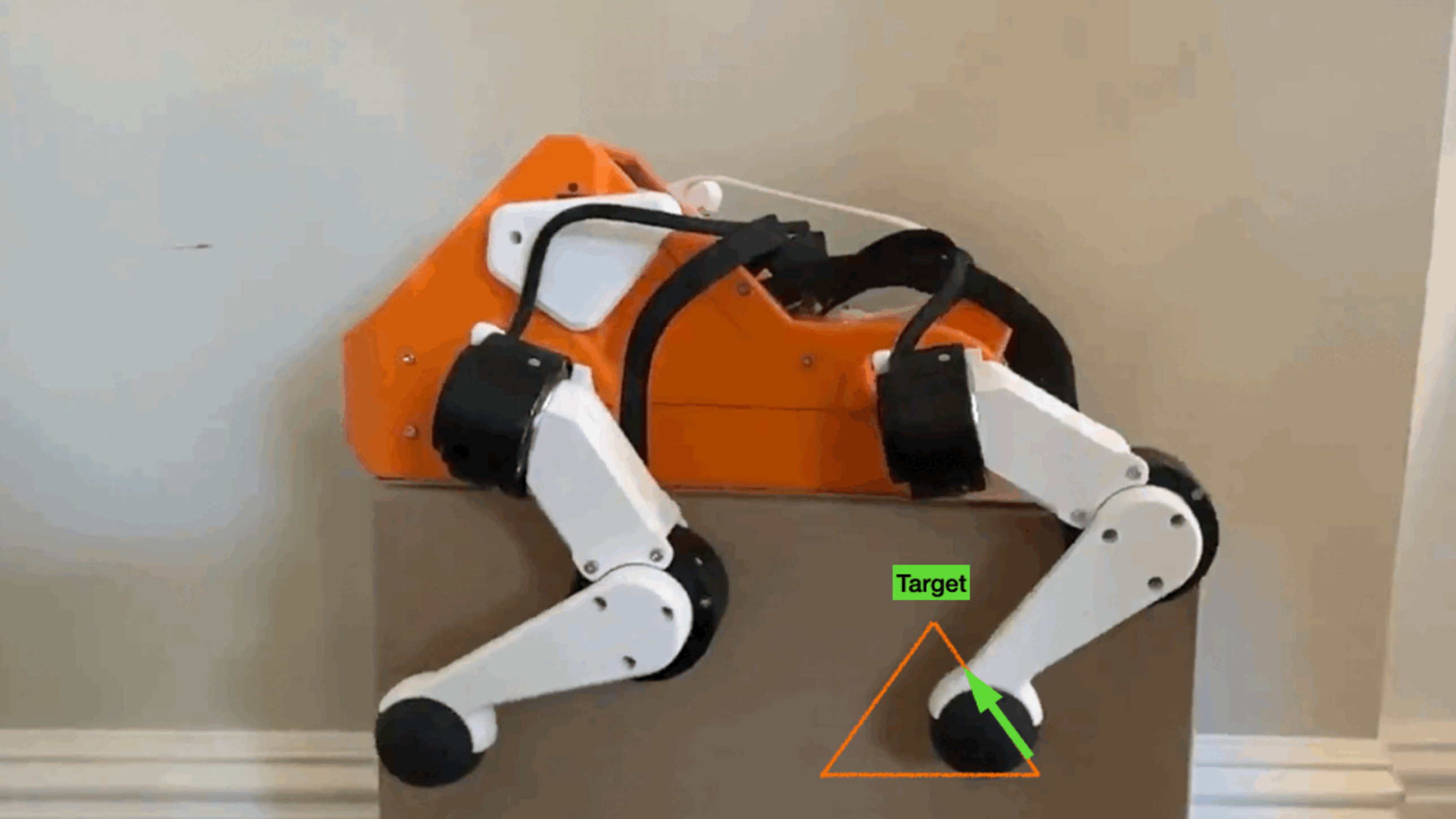
What is this gait?

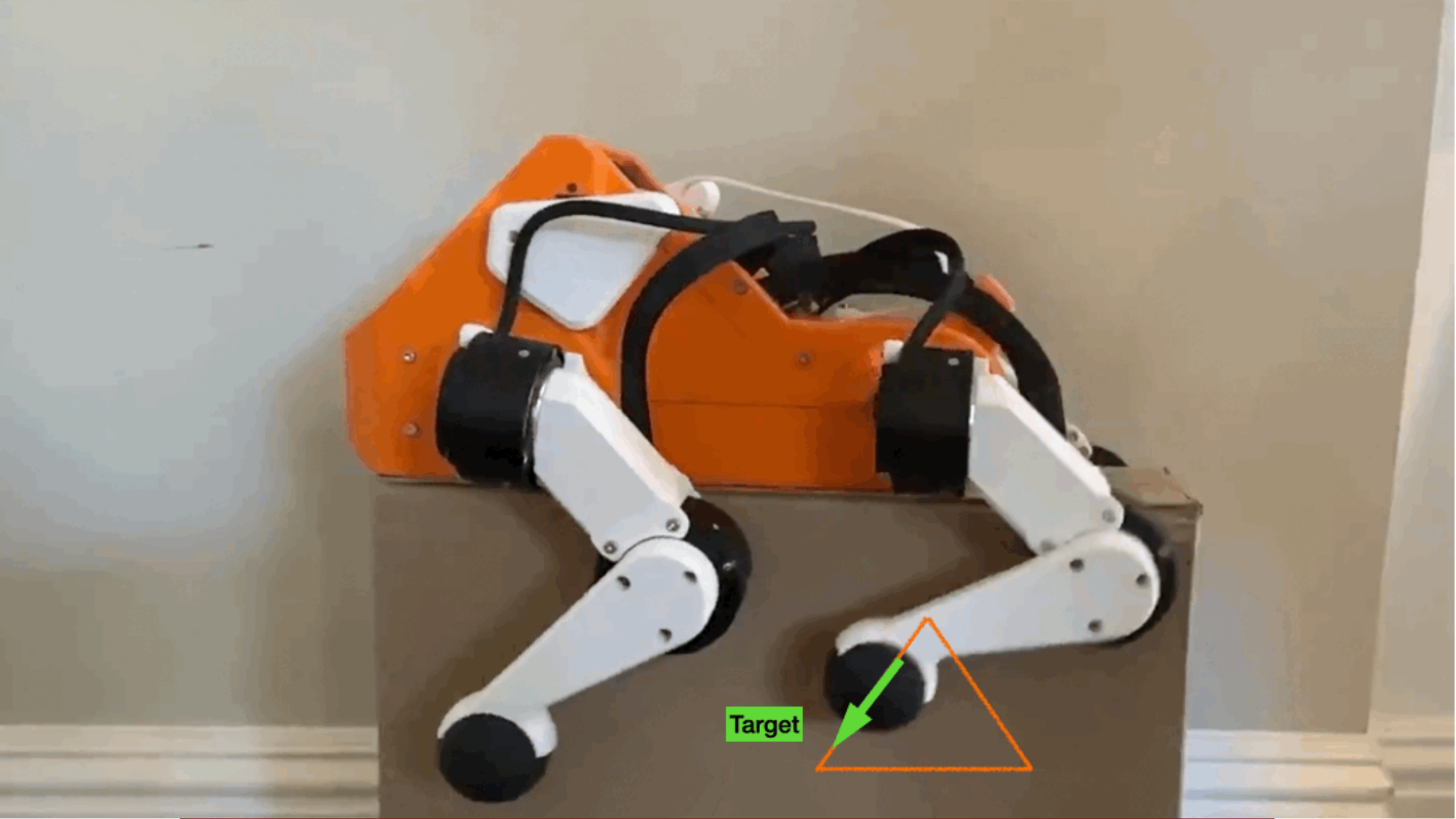
Gait Analysis

Front Right							
Front Left							
Rear Right							
Rear Left							




Target

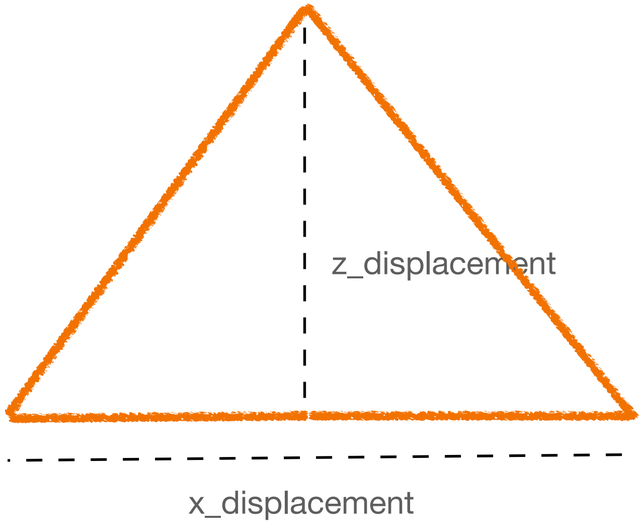

Target

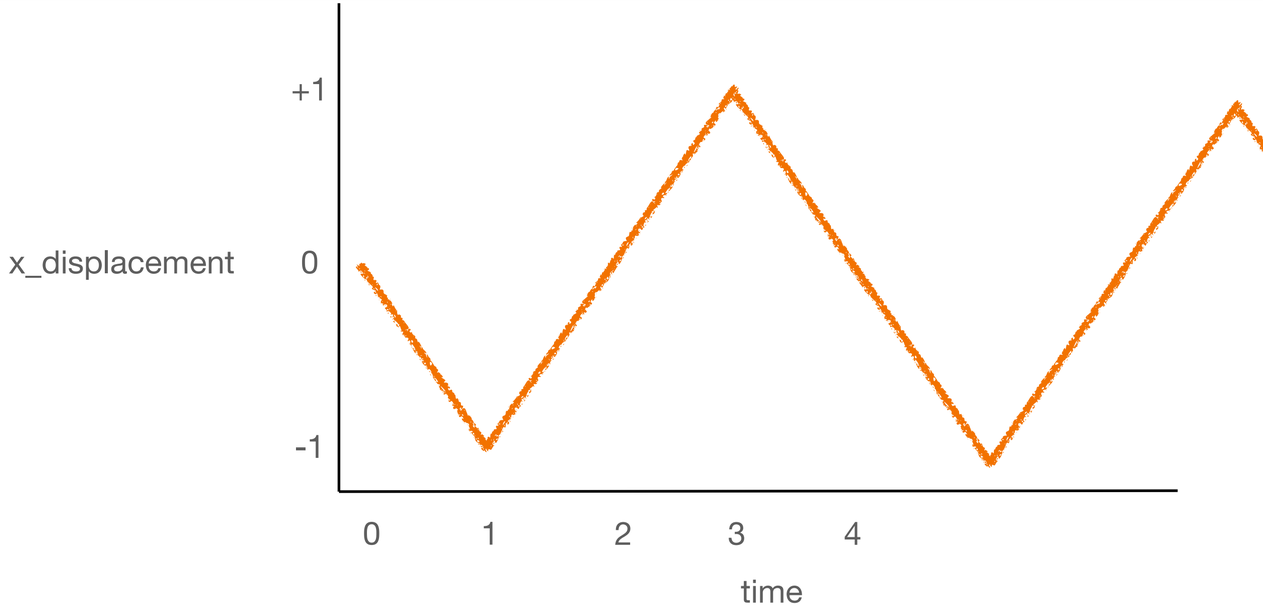

Target

Trot Gait: Foot Control

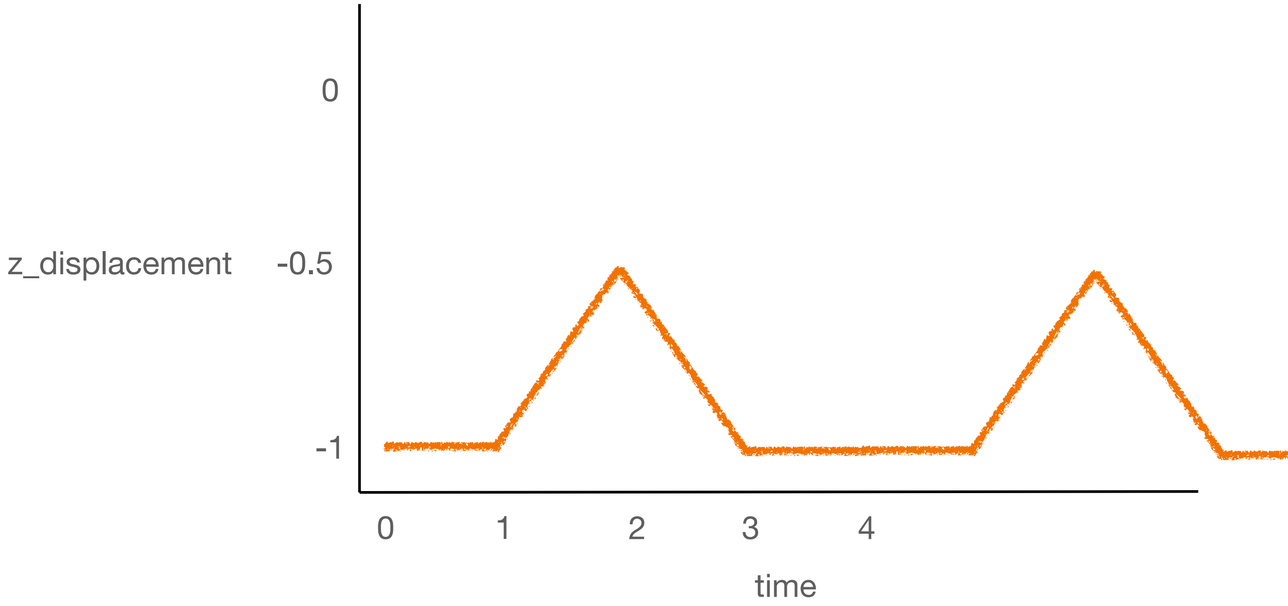
- Each foot moves in a desired pattern.
- From the desired foot position, the correct joint angles must be commanded to produce force
- This can be achieved through Inverse Kinematics

Trot Gait: Foot Control

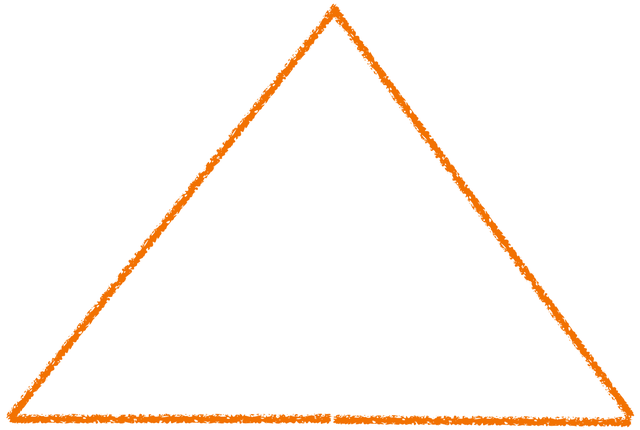





```
x_displacement = target_x_velocity * time_in_stance
z_displacement = fixed_z_displacement

#stance
x_foot_offset = target_x_velocity * dt
z_foot_offset = 0

#swing (first phase)
x_foot_offset = (x_dist_to_touch_down / time_remaining)* dt
z_foot_offset = (swing_height - z_height) / time_remaining)* dt

#swing (second phase)
x_foot_offset = (x_dist_touch_down / time_remaining)* dt
z_foot_offset = (0 - z_height / time_remaining)* dt
```

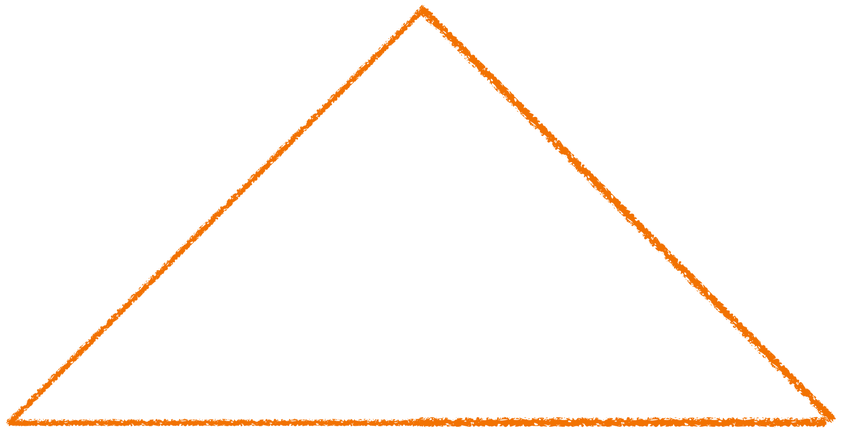


Trot Gait: Foot Control



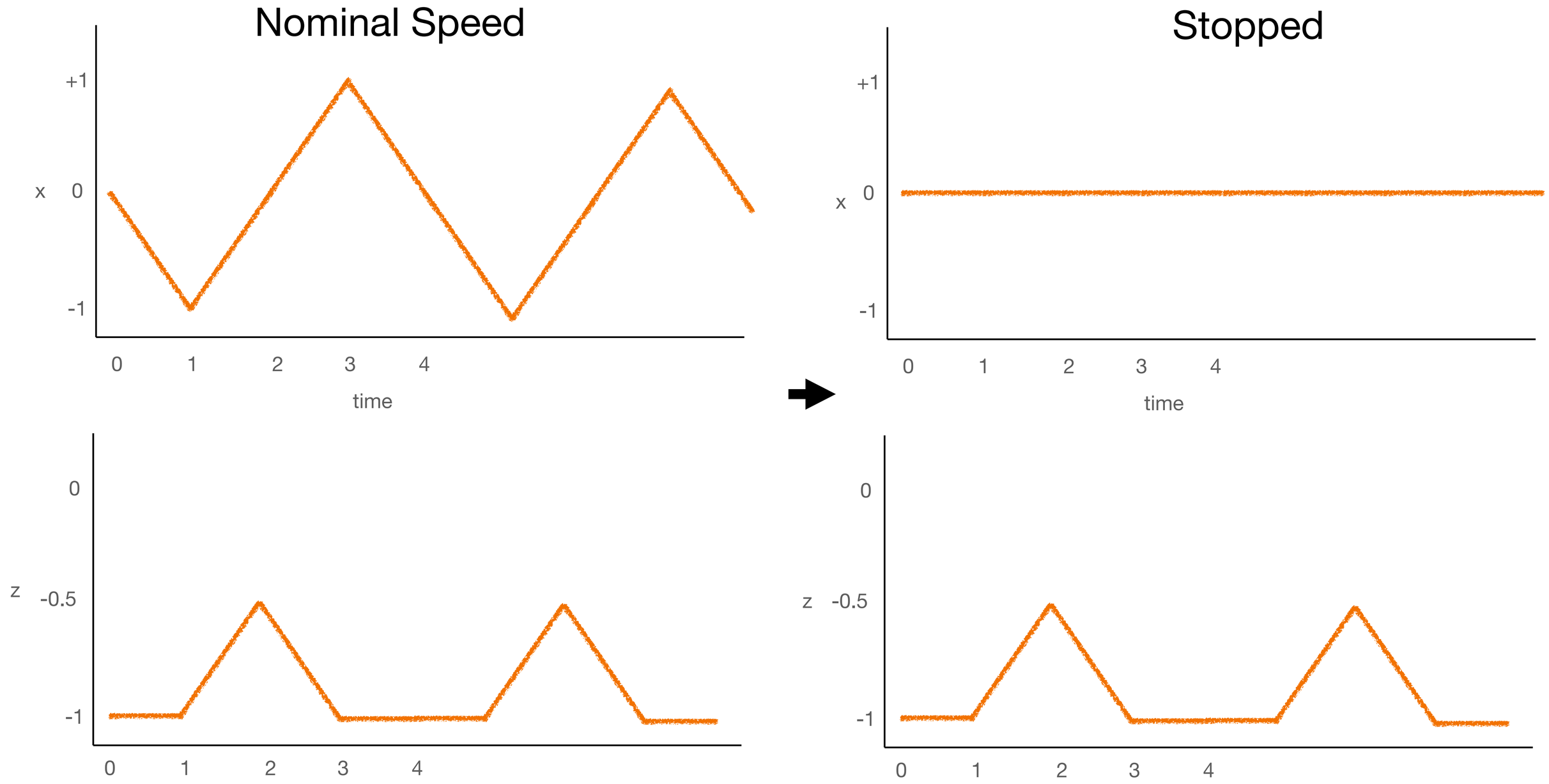
Nominal Speed

Slower



Faster

Trot Gait: Foot Control



Trot Gait: Foot Control

- The pattern itself will have a fixed periodic cycle that doesn’t change.
- To walk faster or slower we will change the shape of the pattern, not the time it takes to trace out

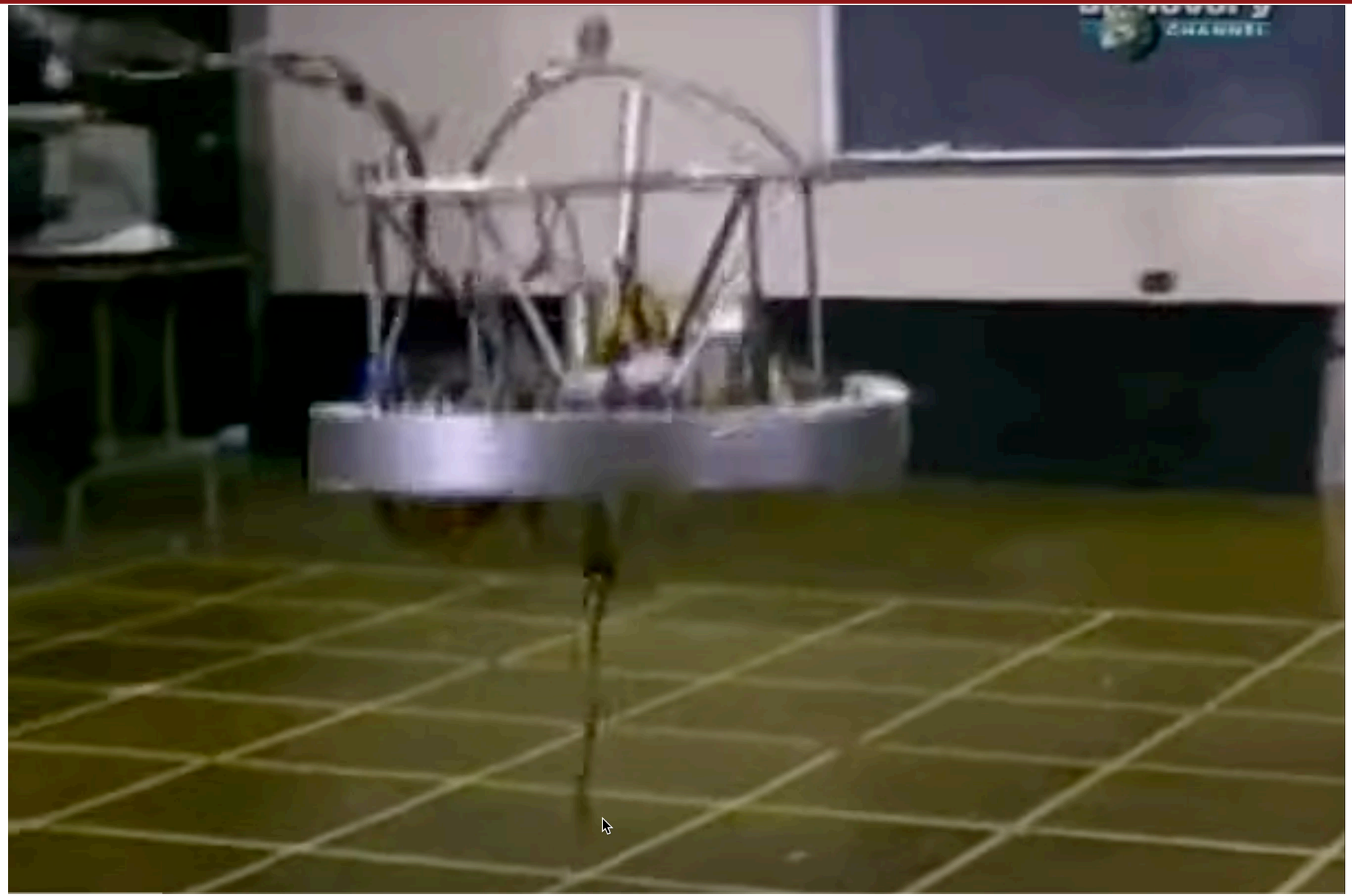
Heuristic Control Recap:

1. Walking is achieved through Inverse Kinematics by setting target positions for the feet.

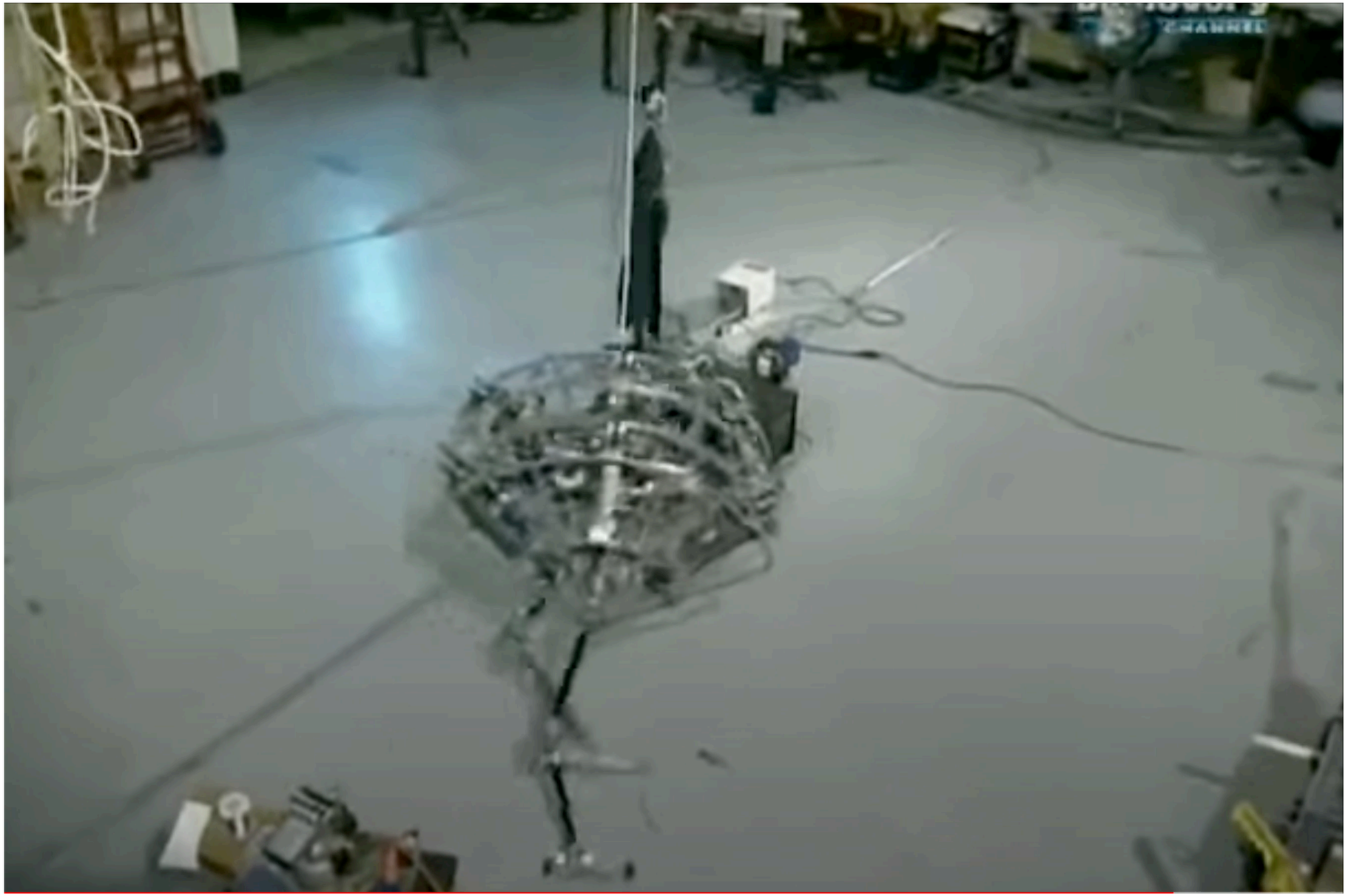
2. Feet are coordinated through a predefined cadence and pattern.

3. Changes in speed are achieved by extending the length of the stride, while leaving the cadence constant.

https://www.youtube.com/watch?v=jACJruCzUzY



https://www.youtube.com/watch?v=XFXj81mvInc



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