Southwest Robotics Symposium

Laminate Quadruped

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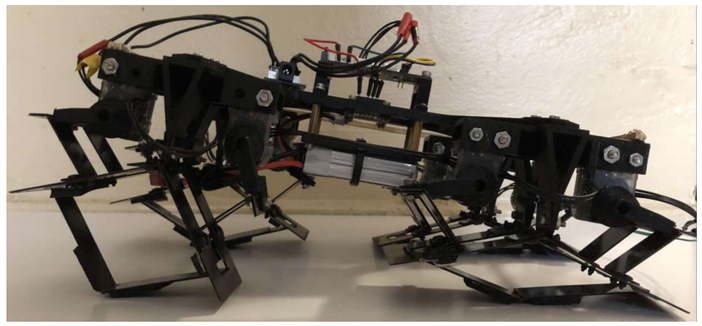
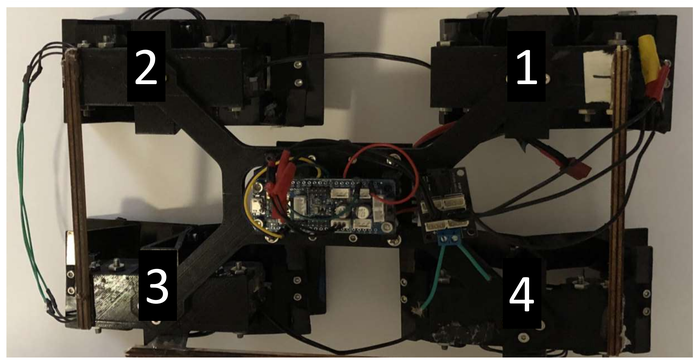
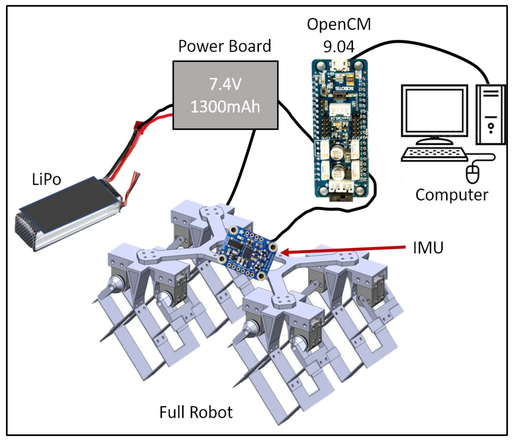
Purpose

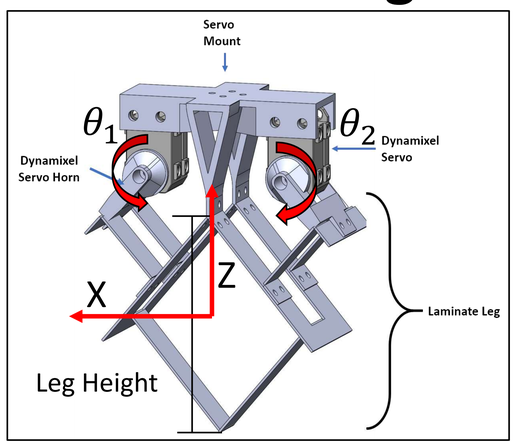
Quadrupedal robots usually are designed with an inherently defined control space or mechanical design. This laminate quadruped provides a rich control space and set of control problems to solve by using a set of more programmable two degree of freedom laminate leg. It was designed and created with rapid prototyping, kinematics simulations, and laminate manufacturing. The primary goals are currently to develop useful walking trajectories and a controller to operate the robot.



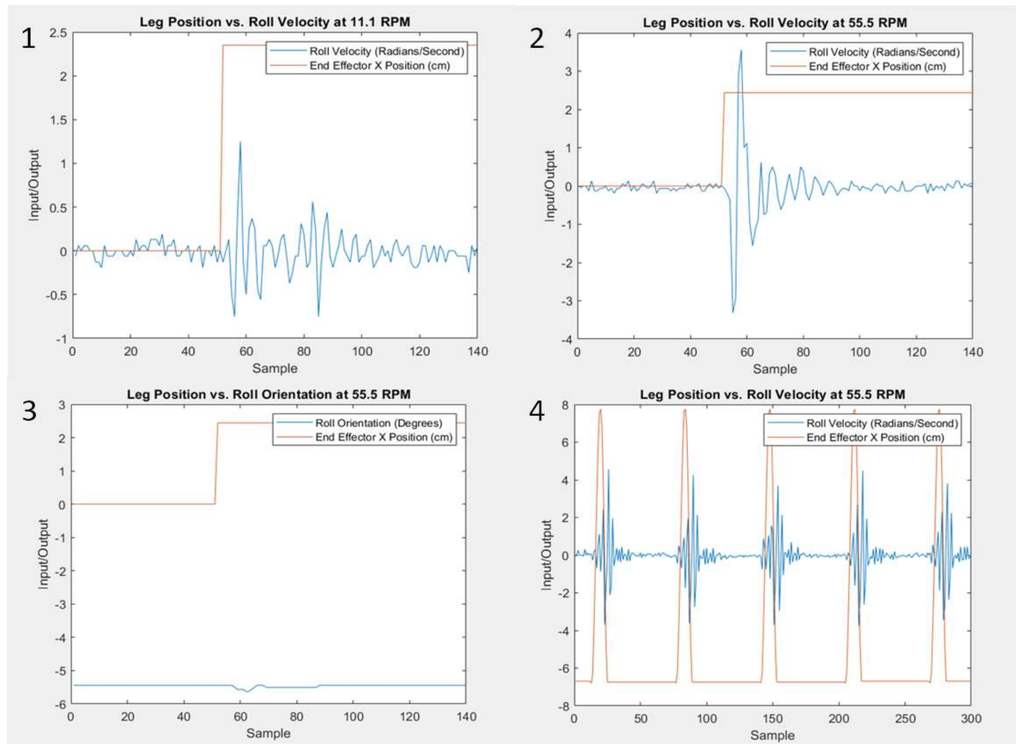


Hardware and Mechanical Design





Data



Experiment Setup

The robot is programmed in the Arduino IDE and outputs IMU data which is captured in Python. One leg of the robot is lifted, and another moves to adjust the roll or pitch. For the data, the center of gravity was also moved to a point that increases the stability of the lifted leg. It is calculated using:

$$Fl - x(mg) = 0$$

F is force, l is side length, x is the position of the CoG, and mg is force due to gravity.

Results and Conclusion

The data reflects results gathered from moving the disturbance leg and observing the system's behavior. Graph 3 shows the position of the lifted leg had minimal affect on the orientation of the robot, meaning our assumption that the disturbance force's position would significantly affect the system was inaccurate. By observing graphs 1 and 2, we can see the disturbance leg's velocity has a much greater affect on the system, but from graph 4 we see that that affect is extremely nonlinear. To get this robot walking in uncertain environments using controls methods, our controller design must account for these nonlinearities and incorporate a MIMO design structure.

IDEAB

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