ME 494 - BTP

Control of Snake Robot

Guides: Prof. Debraj Chakraborty, Prof. Abhishek Gupta

– Saayuj Deshpande

Objective

- To establish a simulation of the snake robot mimicking real world scenario and to test out new control algorithms in the simulation

Methodology

- Utilized MATLAB's Simscape multibody to create simulations of the snake robot
- Tested Simscape-Gazebo co-simulation, but went ahead with Simscape due to simplicity and easy interpretation of signals

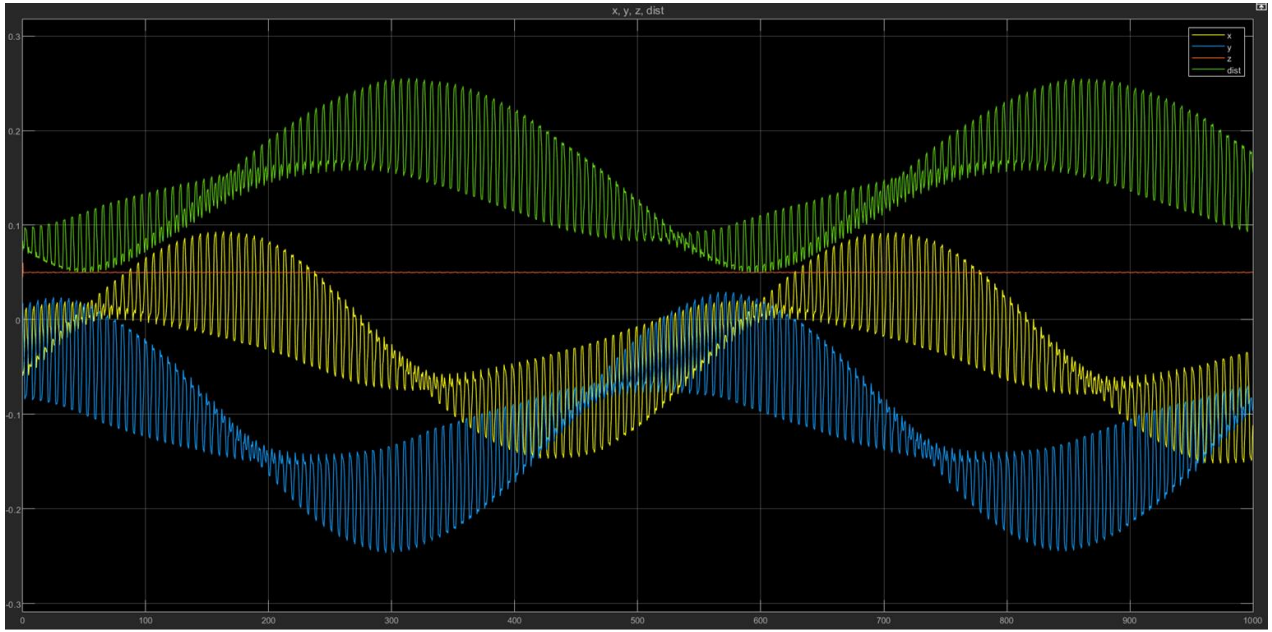
Simulation 1

- Utilized CAD model of link and motor
- Used rigid transforms to connect various links using dimensions from specification sheets
- But this simulation had one link fixed to the world frame, so was only for visual purposes and a stepping stone for next simulation

Simulation 2

- Modelled contact between the ground and the links using the 6 DoF joint and the Spacial Contact Block
- Created a 10-link planar robot, which exhibited motion
- Challenges faced:
    - Robot was sinking in intervals due to problem with ground contact
    - Planar robot exhibiting periodic circular motion, needed either anisotropic friction or serpenoid motion in 2 perpendicular directions

Plot of Displacement with Time



Studying and Testing the Spacial Contact block

- Normal force and friction between block and ground was fluctuating a lot and was not settling easily, resulting in block falling through ground
- Simscape uses a single point force to simulate contact at each time instant, resulting in block falling
- Utilized contact proxies (spheres) at corners of cuboid to simulate contact with ground

Simulation 3

- Created Simscape model of 10-link snake using cuboids as links
- Revolute joints axes aligned alternatively perpendicular to each other
- Contact proxies placed at all corners of links
- Stiffness and damping calculated and given as input
- Snake revolutes periodically when amplitudes and frequencies of the angular position profile input to the revolute joints are same
- Promising results obtained for any asymmetry

Future Work

- Model anisotropic friction
- Optimize lifting of links