

## The Mobile Servicing System (MSS)

- Robotic system used on NASA's International Space Station (ISS)
- Plays a key role in maintenance and assembly of the ISS
- Services instruments and other payloads attached to the ISS
- The MSS CanadArm2's functionality is does not meet NASA's standards for future goals
- The arm's movement only gives it access to certain parts of the station.



Figure 1. International Space Station with a docked space shuttle

### The MSS is composed of three major parts:

1. Space Station Remote Simulator System (aka the CanadArm2)
2. Special Purpose Dexterous Manipulator (aka Dextre)
3. Mobile Remote Servicer Base System

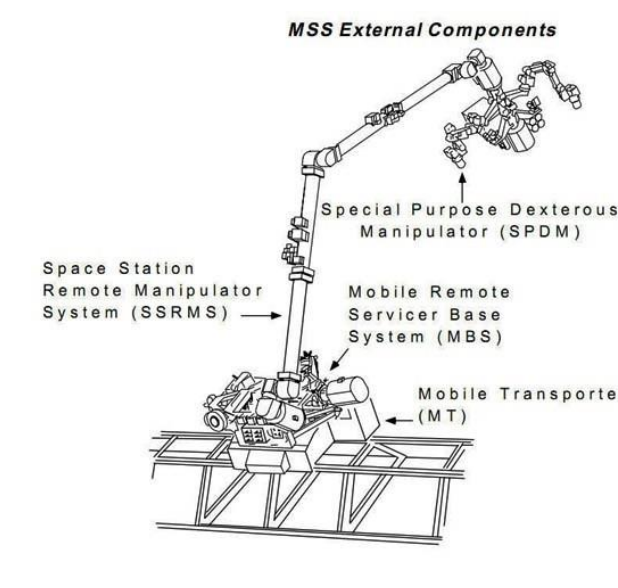


Figure 2. The Mobile Servicing System and its three major components.

## Our Motivation and Goals

### Motivation for Simulation

- Test our mechanism's functionality with given parameters; there could be possible changes necessary to improve the model
- Reduce any chance of singularities or degeneracies, which are positions where the manipulator is limited in kinetic movement, that could possibly occur
- Virtual models will give us an idea of what our mechanism will look like when it is built



Figure 3. An Astronaut mounted on the CanadArm2

### Goals

- Develop an idea of suitable, segmented and dynamic mechanism capable of traversing the International Space Station (ISS) if given a specific anchor point.
- Formulate the idea of the mechanism, by virtualizing the proposed manipulator using MATLAB/Simulink and SimMechanics.

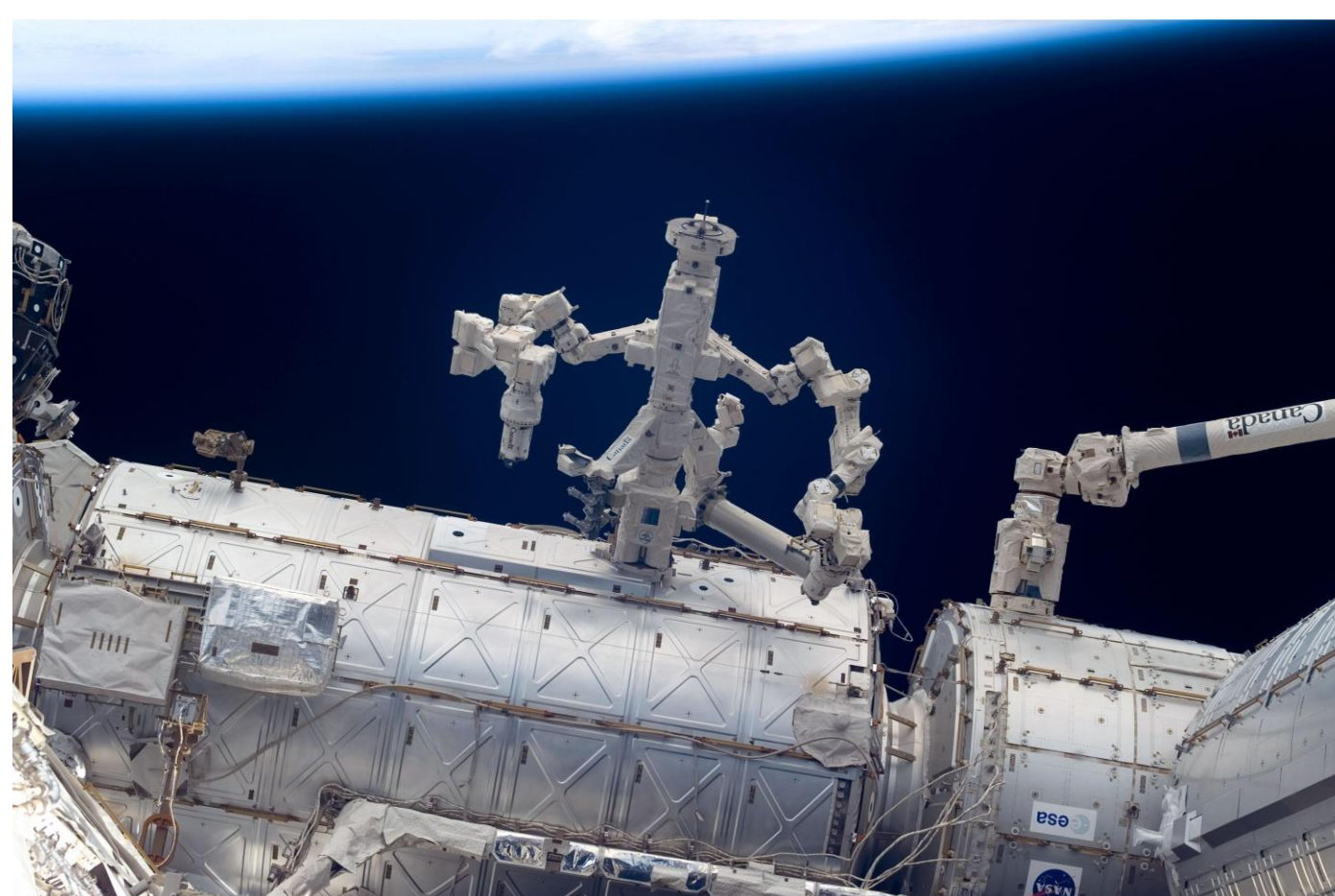
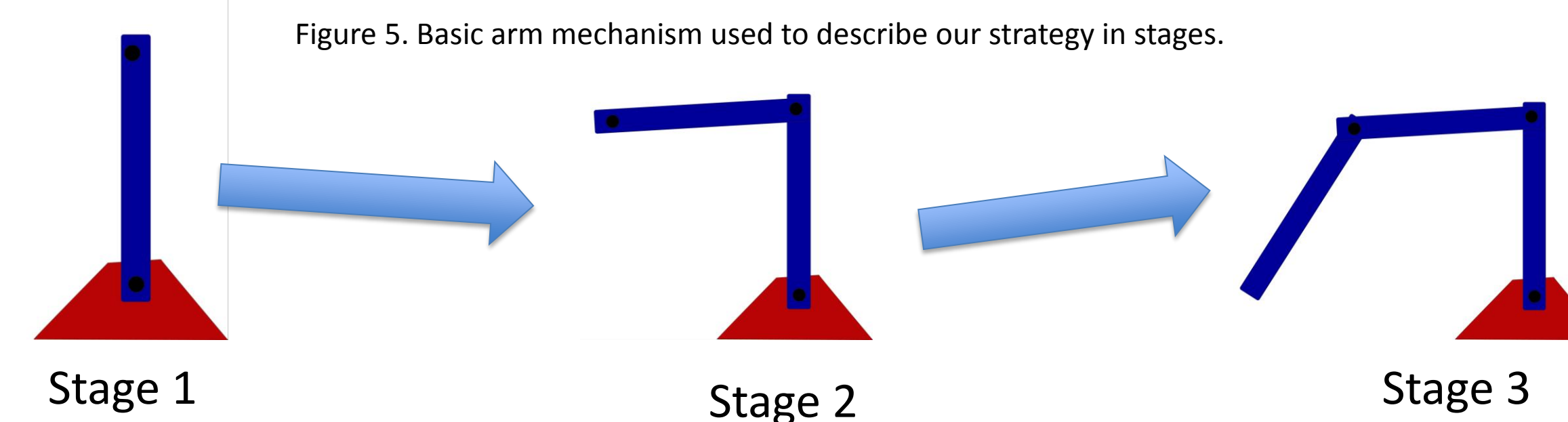


Figure 4. Dextre, one of the three major parts of the MSS.

## Simulation Building Strategy

- We plan to start the construction the simulation based on the strategy of developing a smaller goal
- One this goal is reached, similar goals will be created based on the final outlook of the project and these goals will be constructed using the previously met goals as a base
- The purpose of instantiating this strategy is to prevent making simple mistakes that we would be more prone to make if we were to attempt to solve the problem as a whole



## Process and Development of the Model

- What we would like to do is present a virtual model to first model the proposed mechanism.
- Then derive the equations from the mechanism
- The equations will represent the movement traits of the mechanism such as the displacement, velocity, and acceleration.
- All of the calculations for the various units of measurement will be done in MATLAB
- In order to familiarize myself with MATLAB, various models of mechanisms and their MATLAB code have been found and interpreted in order to understand how MATLAB is used to build and solve equations.

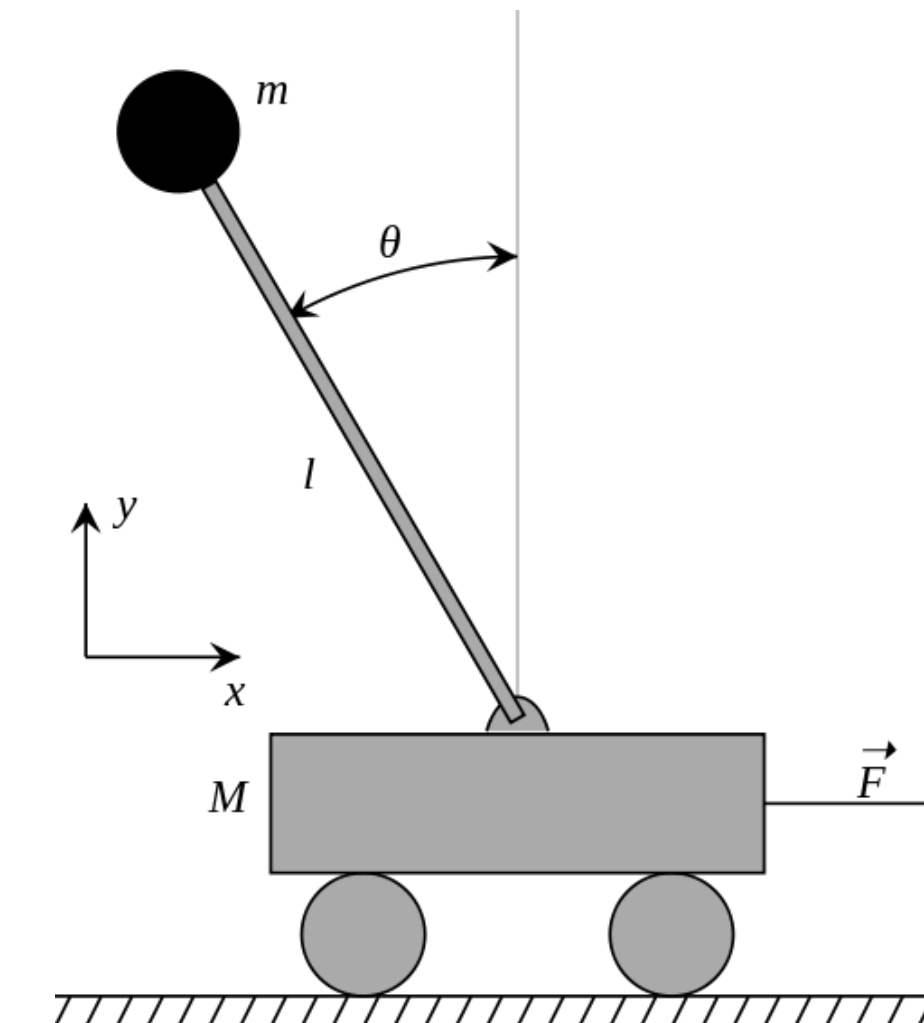


Figure 6. Inverted Pendulum; one of the models used to understand how to derive equations from a mechanism.

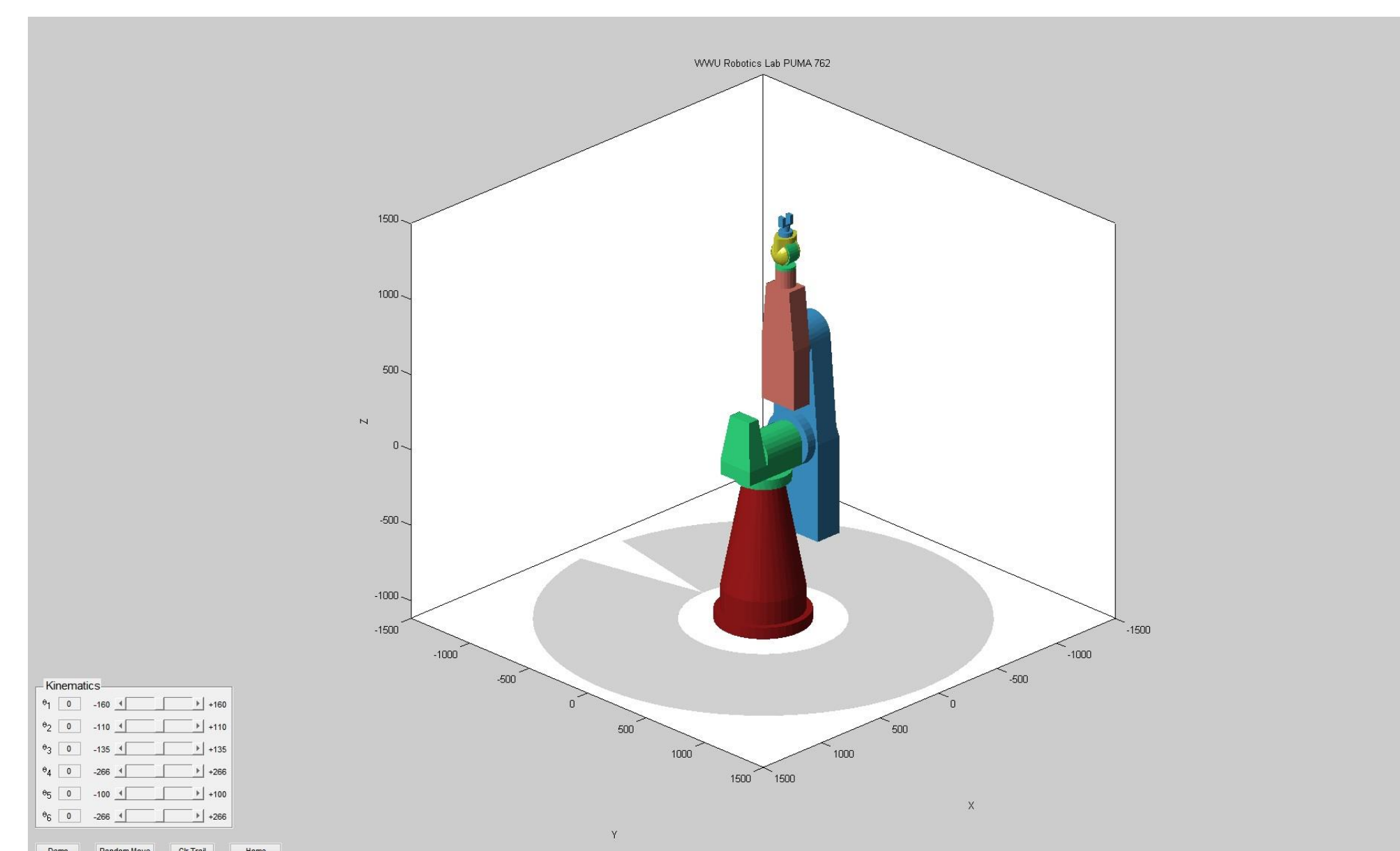
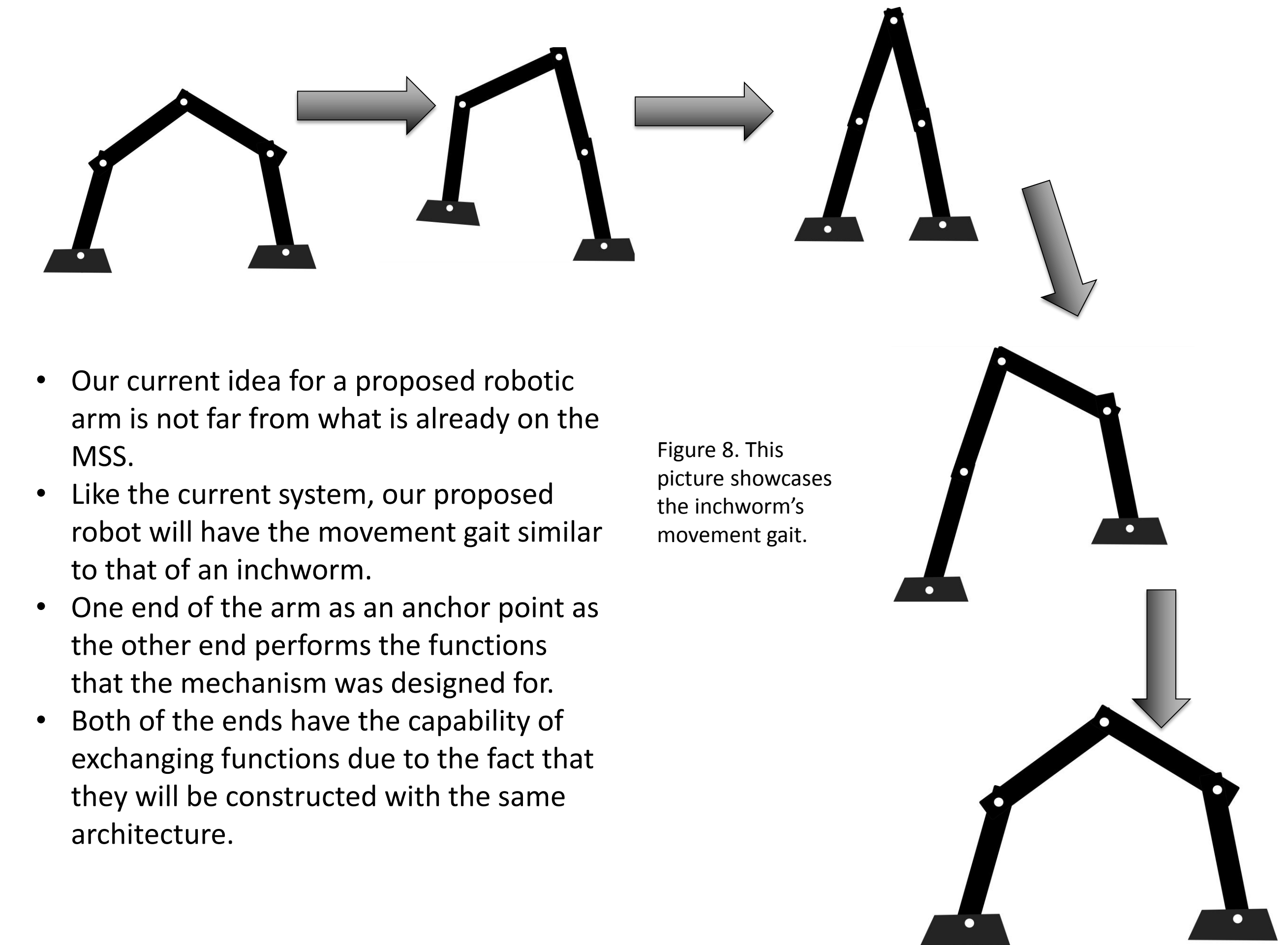


Figure 7. A 6 Degree of Freedom serial manipulator, WWU Robotics Lab PUMA 762. The code for this will also be analyzed for a more advanced understanding of MATLAB.

## Development of the model



- Our current idea for a proposed robotic arm is not far from what is already on the MSS.
- Like the current system, our proposed robot will have the movement gait similar to that of an inchworm.
- One end of the arm as an anchor point as the other end performs the functions that the mechanism was designed for.
- Both of the ends have the capability of exchanging functions due to the fact that they will be constructed with the same architecture.

Figure 8. This picture showcases the inchworm's movement gait.

## Future Plans

- By the end of this summer, we will have developed the first draft of our simulation
- We want to continue reading about the subject to find any additional tools or useful items that could possibly improve our project.
- Evaluate our model based on how many faults it has. Make sure that the model is able to move in all directions if anchored at one point
- Have all the equations necessary to represent the mechanism's motion.
- Submit a final proposal to NASA

## Resources

1. [http://upload.wikimedia.org/wikipedia/commons/e/e5/ISS\\_and\\_Endavour\\_s\\_eeen\\_from\\_the\\_Soyuz\\_TMA-20\\_spacecraft\\_14.jpg](http://upload.wikimedia.org/wikipedia/commons/e/e5/ISS_and_Endavour_s_eeen_from_the_Soyuz_TMA-20_spacecraft_14.jpg)
2. [http://forum.celestialmatters.org/userpix/6\\_mobile\\_servicing\\_system\\_1.jpg](http://forum.celestialmatters.org/userpix/6_mobile_servicing_system_1.jpg)
3. [http://upload.wikimedia.org/wikipedia/commons/e/e5/STS-114\\_Steve\\_Robinson\\_on\\_Canadarm2.jpg](http://upload.wikimedia.org/wikipedia/commons/e/e5/STS-114_Steve_Robinson_on_Canadarm2.jpg)
4. [http://www.nasa.gov/images/content/287299main\\_dextre\\_iss017\\_big\\_full.jp](http://www.nasa.gov/images/content/287299main_dextre_iss017_big_full.jp)
5. [http://en.wikipedia.org/wiki/Inverted\\_pendulum](http://en.wikipedia.org/wiki/Inverted_pendulum)
6. <http://www.mathworks.com/matlabcentral/fileexchange/14932-3d-pum-swevrobot-demo/content/puma3d.m>