DISARM Milestone 3

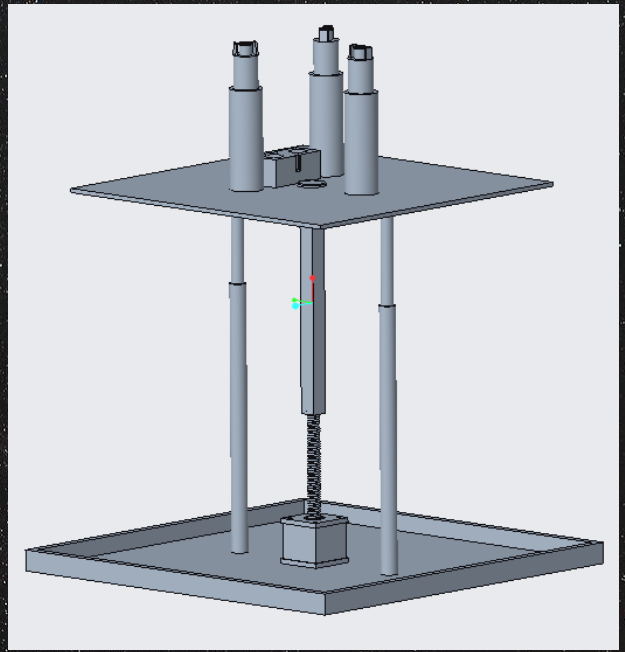
Debris **I**n **S**pace **A**utonomous **R**emoval **M**echanism

12/4/2020

Content

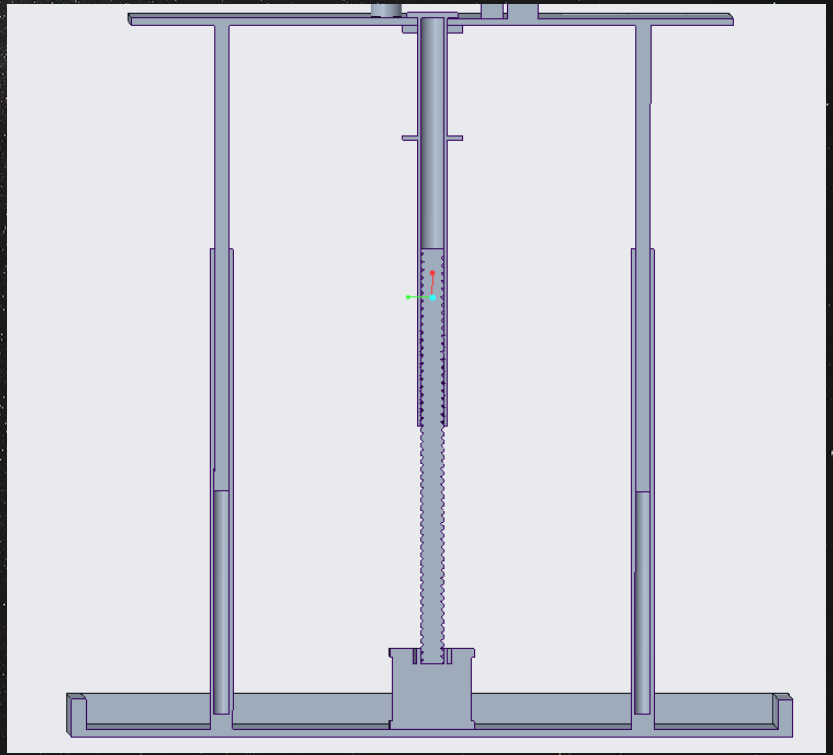
What is DISARM?

An single-use, autonomous, and universal space debris grappling device that uses capacitor discharge stud welding as its method of attachment.

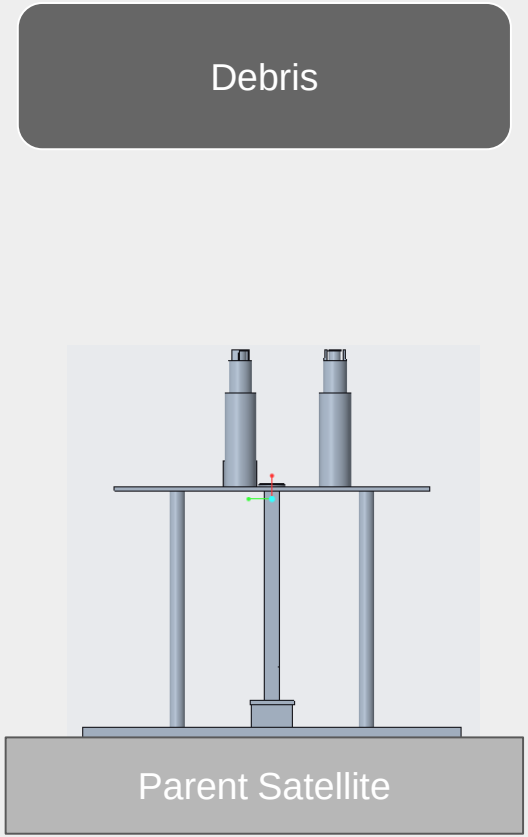


Model of the DISARM design.

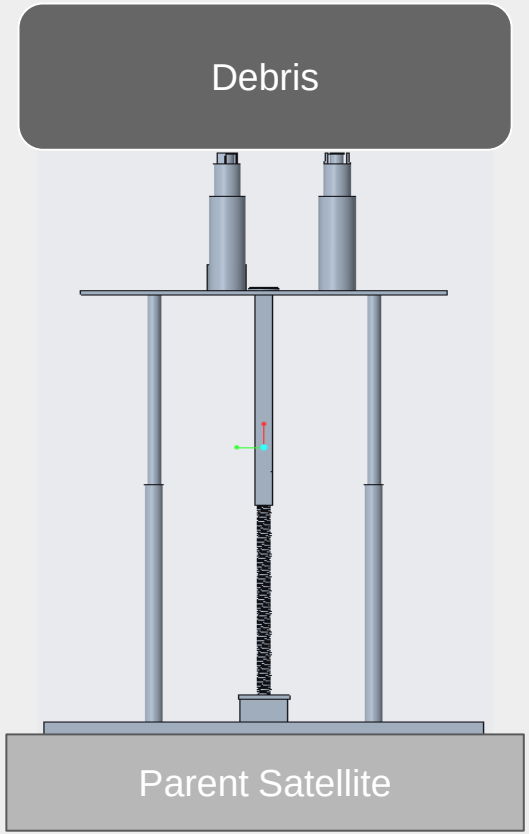
- DISARM is designed to be able to grapple a 27U cubesat sized (54kg) orbital debris
- Our prototype design will prove the feasibility of capacitor discharge stud welding for space debris removal
- Our prototype is not a fully-fledged satellite, but rather an attachment system for a pre-existing one



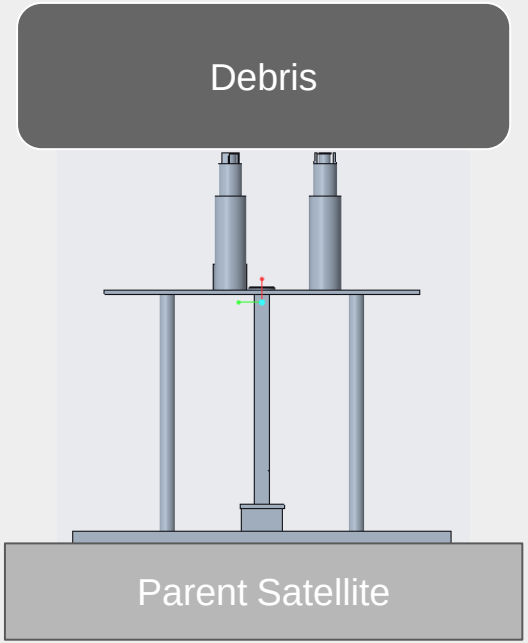
DISARM Prototype Operation



DISARM Fully Retracted

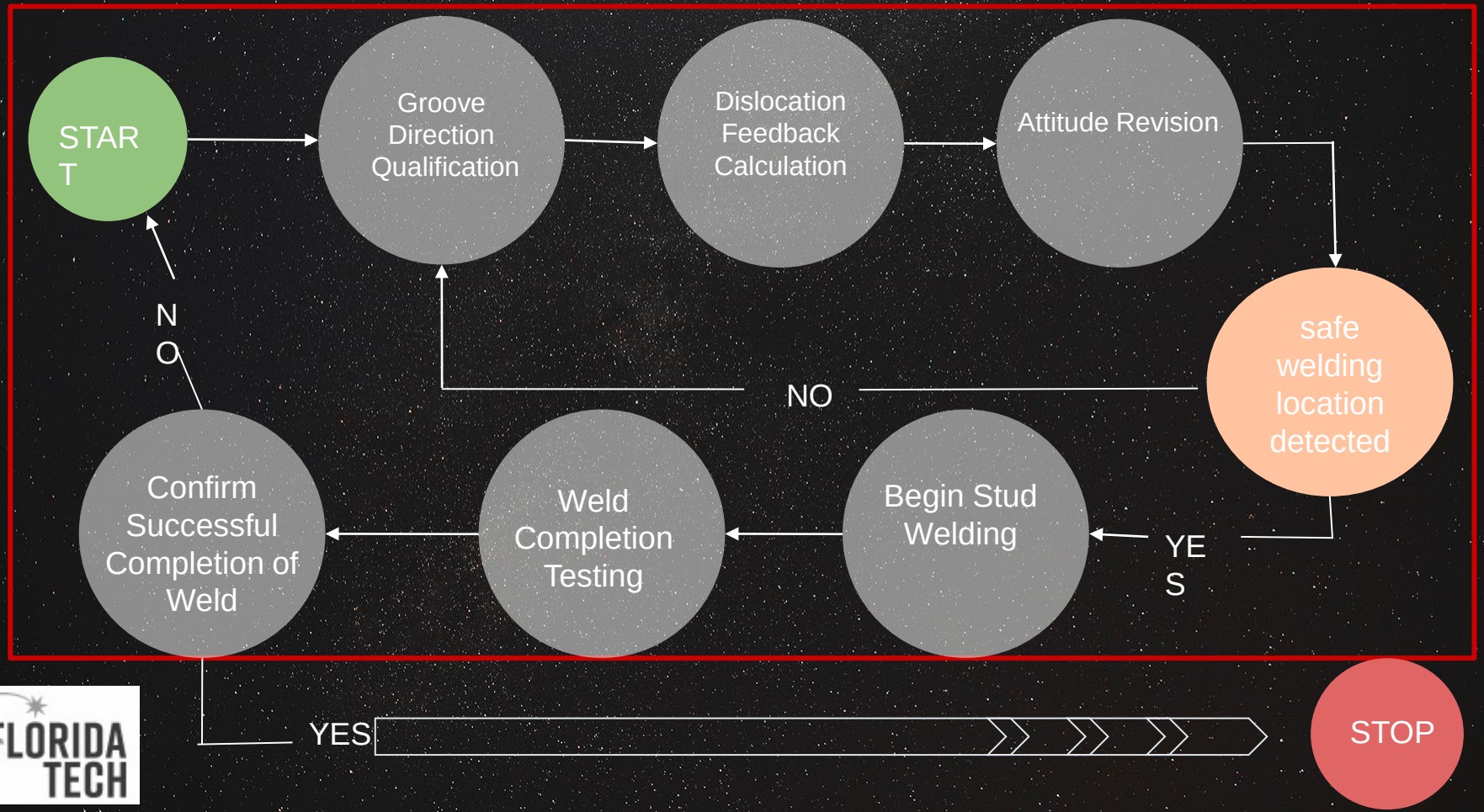


DISARM Fully Extended



DISARM Fully Retracted

MISSION CONTROL FLOW



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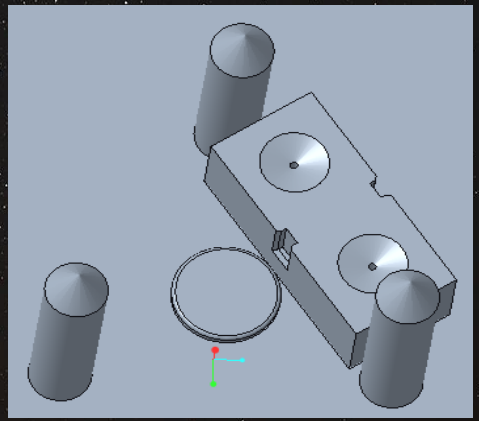
Sensor

Lidar-Lite LED V4

Lidar-Lite LED V4	Properties
Unit Size (H x W x D)	52.2 x 21.2 x 24.0 mm
Weight	14.6 g
Accuracy	±1cm to 2m, ± 2cm to 4m ± 5cm to 10m
Range	5 cm -10 m
Interface	I2C or ANT
Power	4.75-5.25 V
Price	$59.95



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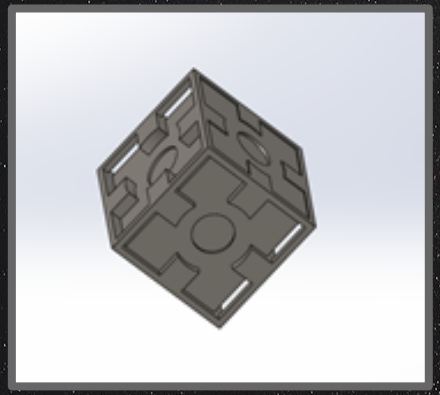
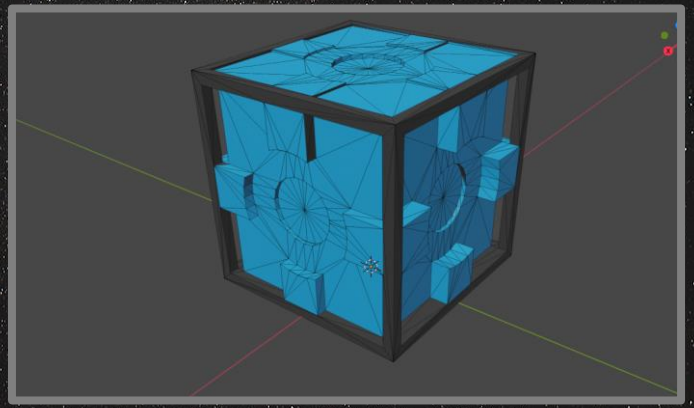
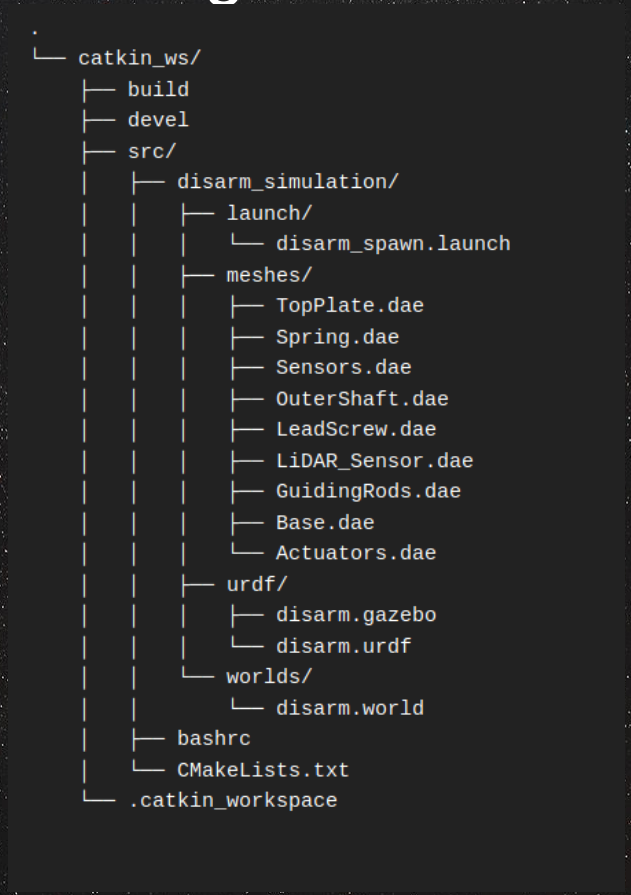
New Test Debris Models





Cubesat Model	1 Unit	6 Unit	27 Unit
Dimensions(cm)	10 x 10 x 10	12 x 24 x 36	34 x 35 x 36
Extrusion Depths(cm)	1.5	2.5	10.5
Extrusion Radius(cm)	0.1	1.0	2.7

Current System Diagram



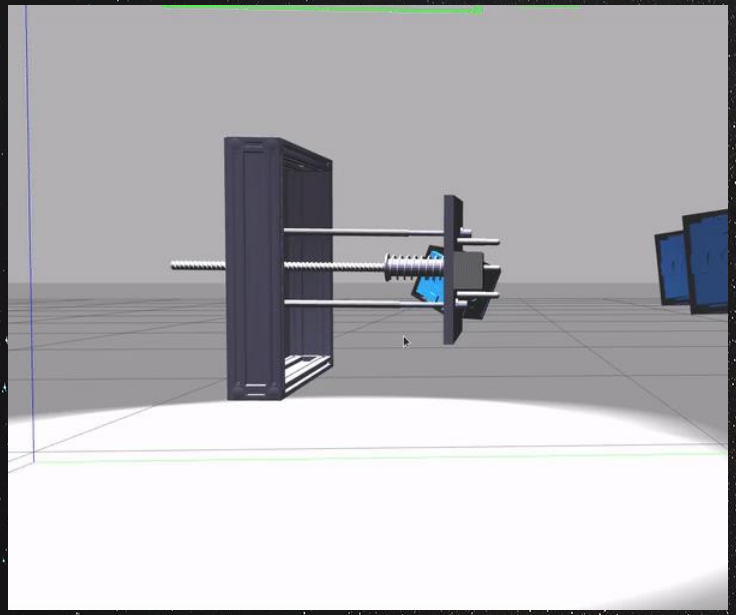
disarm_spawn.launch

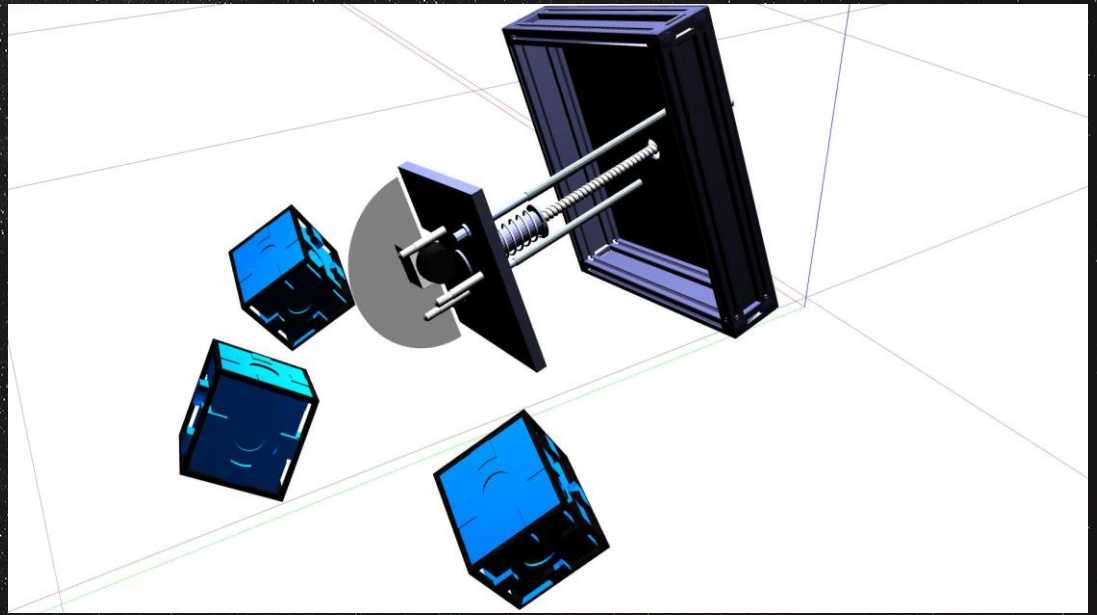
```
<?xml version="1.0" encoding="UTF-8"?>
  <launch>

    <!-- We resume the logic in empty_world.launch -->
    <include file="$(find gazebo_ros)/launch/empty_world.launch">
    <arg name="world_name" value="$(find disarm_simulation)/worlds/disarm.world"/>
    <arg name="debug" value="$(arg debug)" />
    <arg name="gui" value="$(arg gui)" />
    <arg name="paused" value="$(arg paused)"/>
    <arg name="use_sim_time" value="$(arg use_sim_time)"/>
    <arg name="headless" value="$(arg headless)"/>
    </include>

    <param name="robot_description" command="cat '$(find disarm_simulation)/urdf/DISARM.urdf'" />
    <node name="spawn_urdf" pkg="gazebo_ros" type="spawn_model" output="screen" args="-urdf -param robot_description -model DISARM" />
  </launch>
```

disarm.gazebo

```
<robot>
  <gazebo reference="LiDAR_Sensor">
    <sensor type="gpu_ray" name="Head_LiDAR_Sensor">
      <pose>0 0 0 0 0 0</pose>
      <visualize>true</visualize>
      <update_rate>40</update_rate>
      <ray>
        <scan>
          <horizontal>
            <samples>720</samples>
            <resolution>1</resolution>
            <min_angle>-1.570796</min_angle>
            <max_angle>1.570796</max_angle>
          </horizontal>
        </scan>
        <range>
          <min>0.50</min> <!--meters-->
          <max>10.0</max>
          <resolution>0.01</resolution>
        </range>
        <noise>
          <type>gaussian</type>
          <mean>0.0</mean>
          <stddev>0.01</stddev>
        </noise>
      </ray>
      <plugin name="gazebo_ros_head_hokuyo_controller" filename="libgazebo_ros_gpu_laser.so">
        <topicName>/disarm_simulation/laser/scan</topicName>
        <frameName>hokuyo</frameName>
      </plugin>
    </sensor>
  </gazebo>
</robot>
```

Result Simulation Launch





Next Steps

- Fix sensor range not working properly
- Complete rest of simulation requirements, demonstrating DISARM welding unto test debris before next semester
- Apply simulation code unto real-world devices upon purhcase

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THANK YOU!

Any Questions?

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