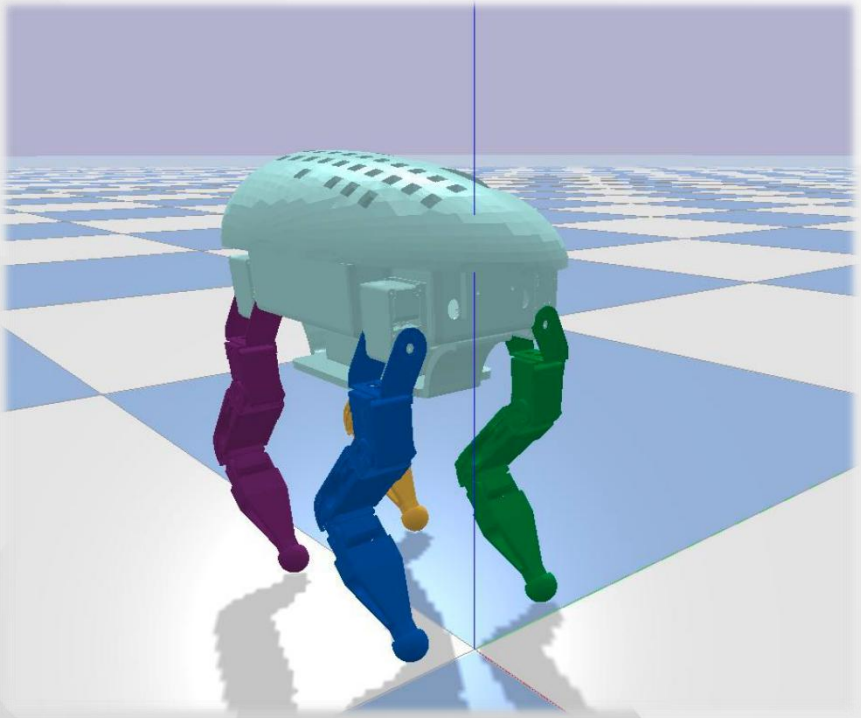
Robotics Studio MECE 4611



Mechi

Spring 2020 Team #6

Chia-Ho Hsiung **ch3472**

Yujia Zhai **yz3653**

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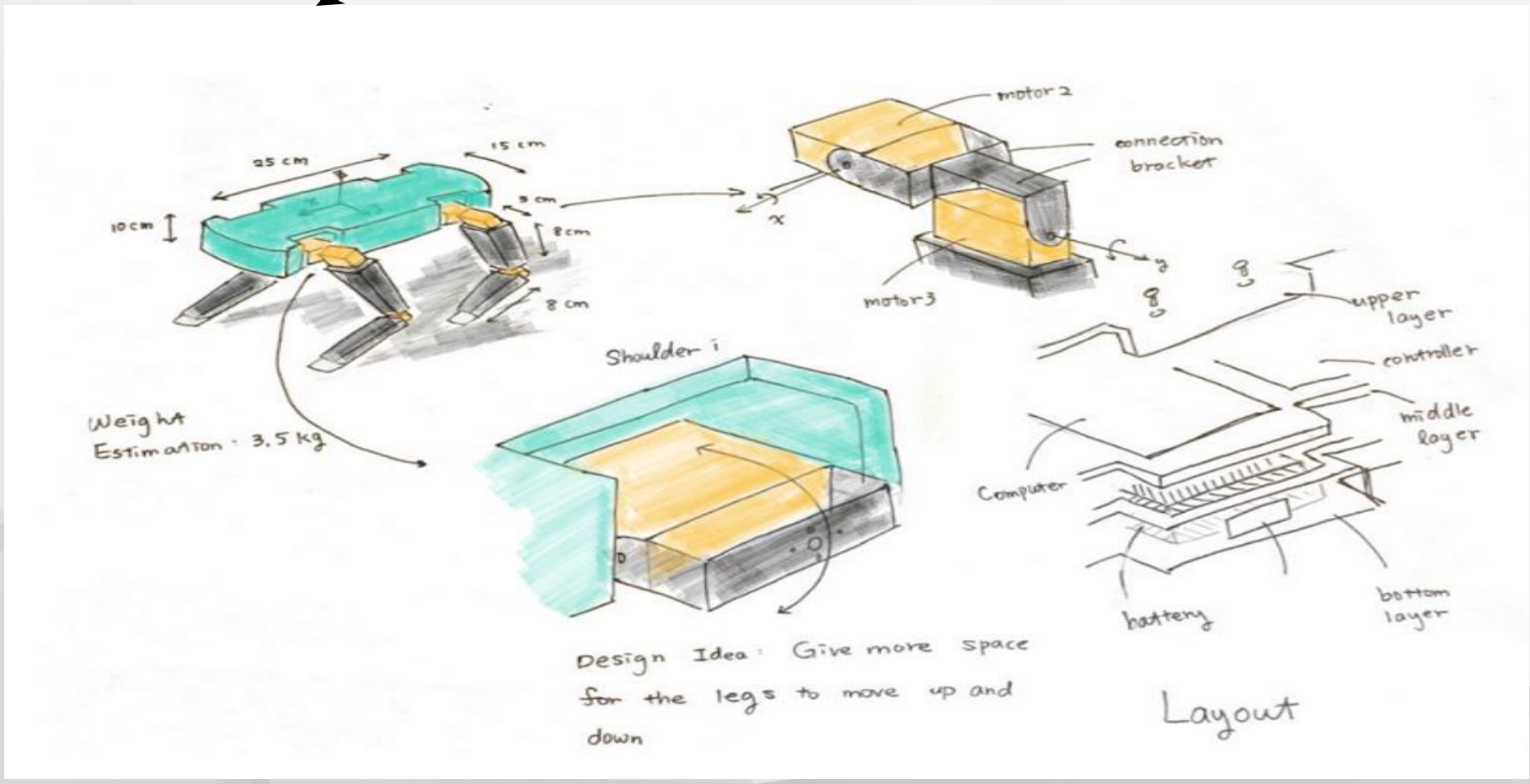
Concept Mechi2



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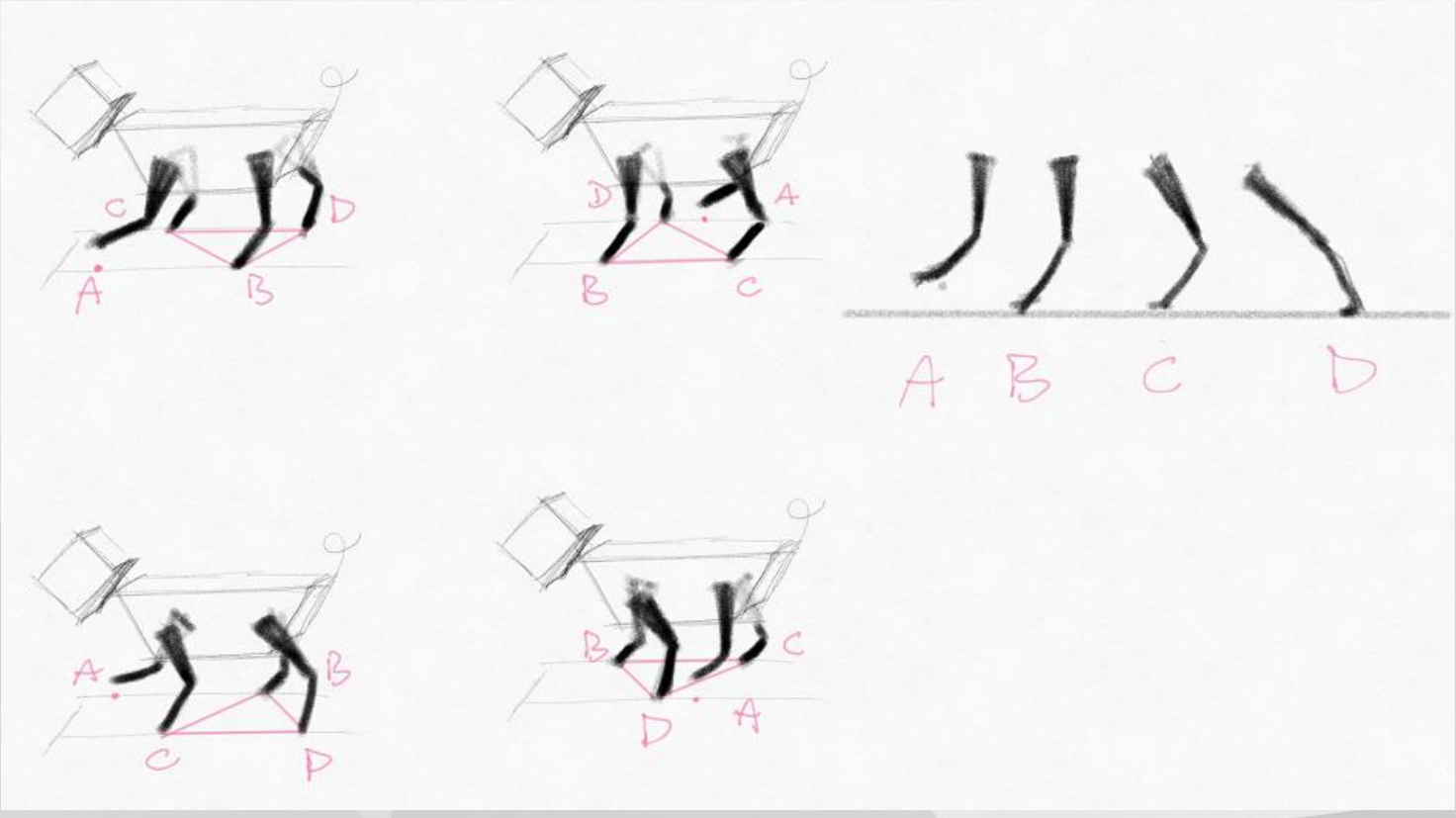
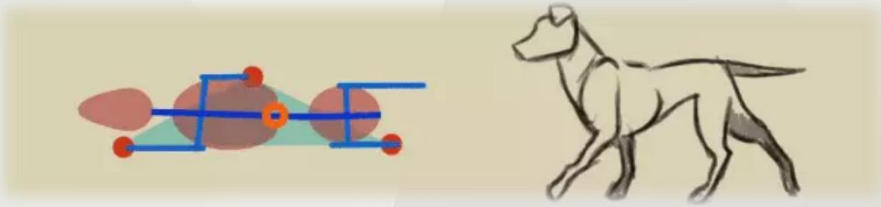
GAIT AND STABILITY





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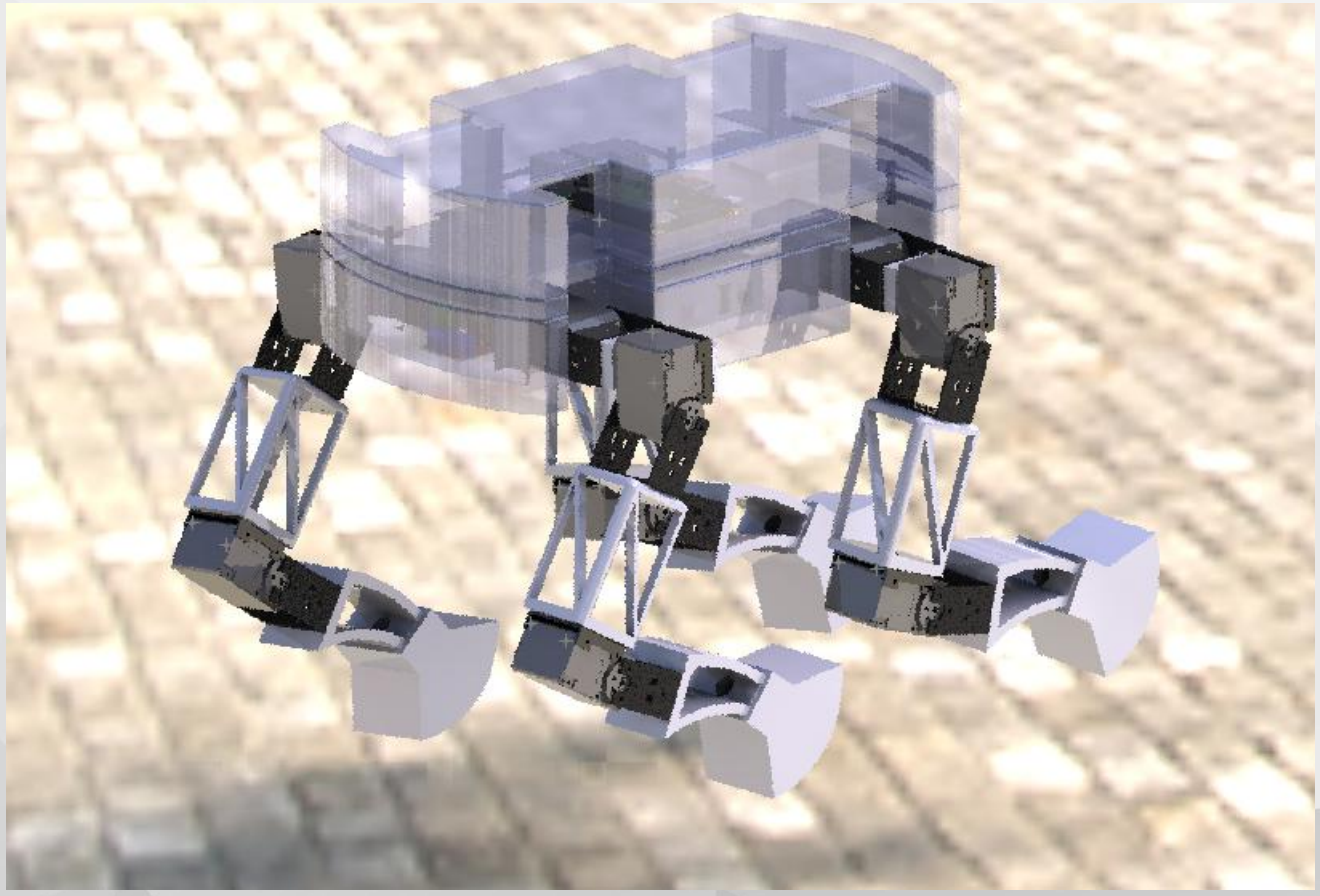
CAD rendering



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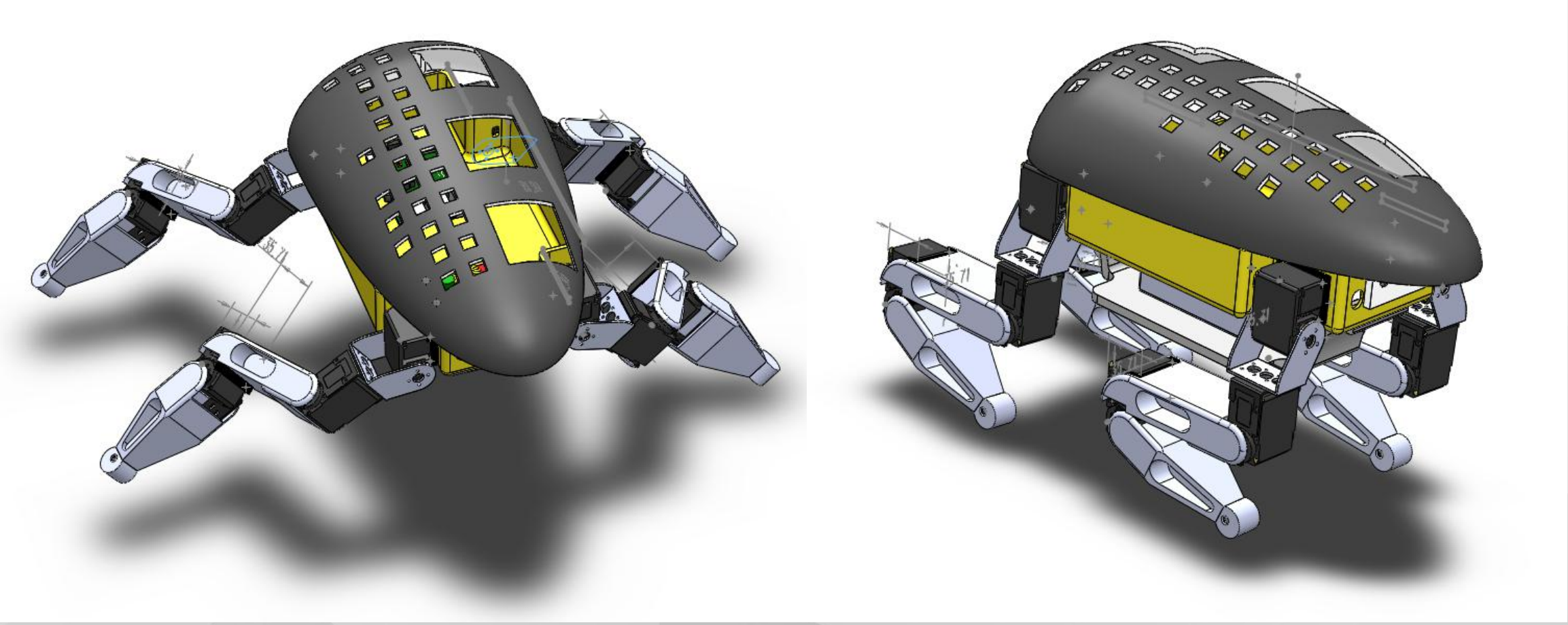
3D Rendering

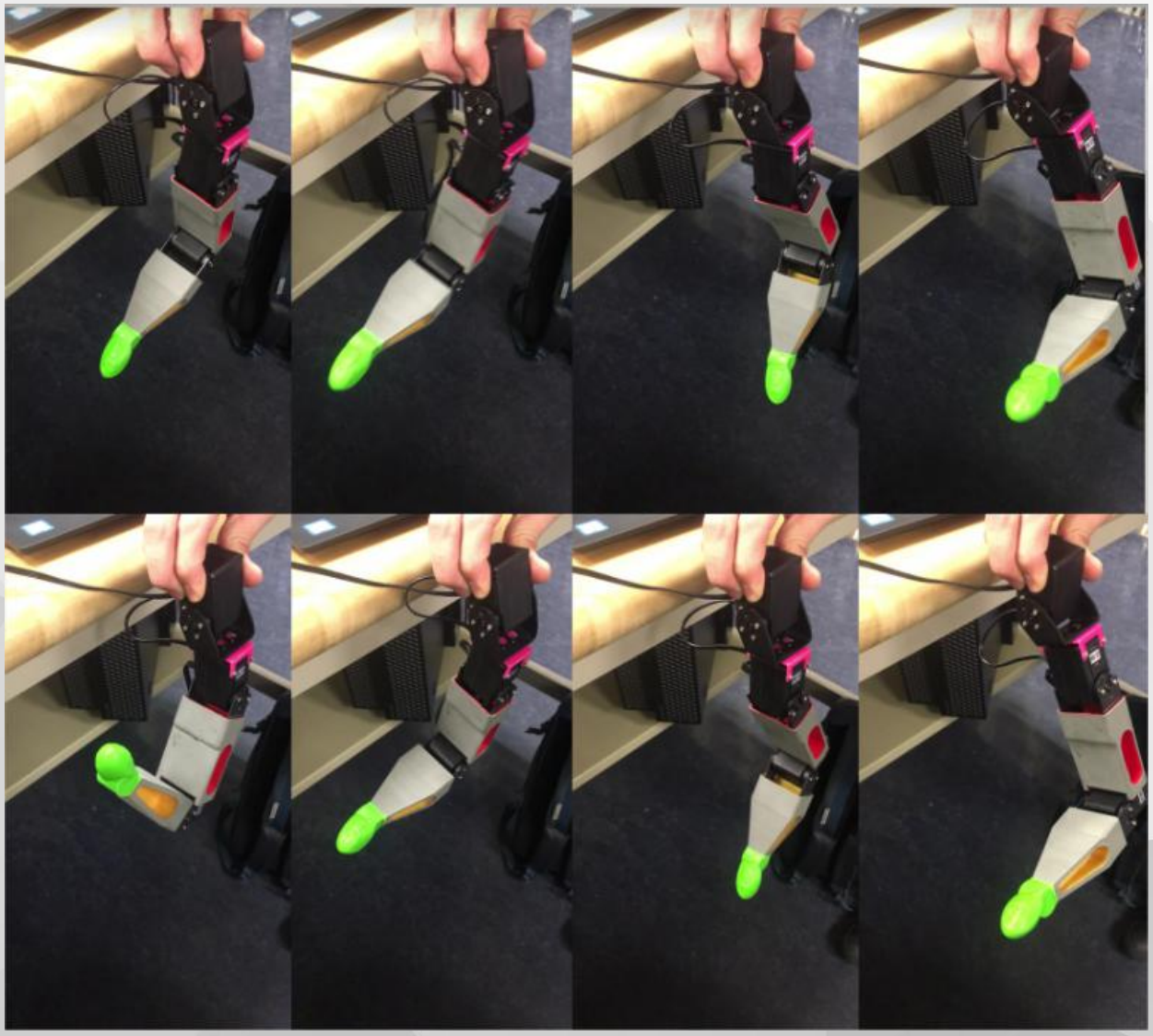
Robot Dog in the Black Mirror Series

Poses



Photorealistic Rendering

Working leg



Video Link: https://youtu.be/uwKpqAC1LLI

URDF

```
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  <inertial>
    <origin
      xyz="-0.12811 0.024461 -0.0044622"
      rpy="0 0 0" />
    <mass value="2.4" />
    <inertia
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      ixy="4.7216E-06"
      ixz="4.9666E-05"
      iyy="0.003507"
      iyz="8.7588E-06"
      izz="0.0043338" />
  </inertial>
  <visual>
    <origin xyz="0 0 0" rpy="0 0 0" />
    <geometry>
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    </geometry>
    <material name="white"/>
  </visual>
  <collision>
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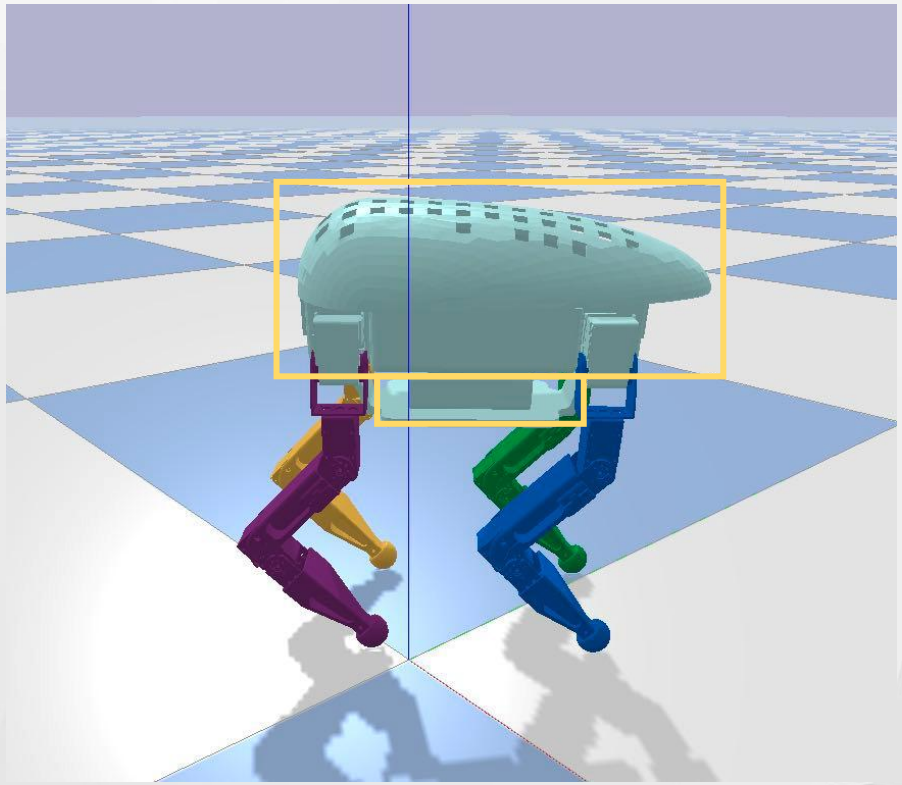

- base link is the body(include three part together)
- all links include the mass, inertial, collision

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URDF

```
<link name="shoulder1">
  <inertial>
    <origin
      xyz="-0.019988 0.011936 -0.04778"
      rpy="0 0 0" />
    <mass
      value="0.052919" />
    <inertia
      ixx="1.2507E-05"
      ixy="3.8607E-11"
      ixz="-1.1777E-10"
      iyy="1.1715E-05"
      iyz="2.2809E-07"
      izz="7.9602E-06" />
  </inertial>
  <visual>
    <origin
      xyz="0 0 0"
      rpy="0 0 0" />
    <geometry>
      <mesh
        filename="package://whole3/meshes/shoulder1.STL" />
    </geometry>
    <material name="green"/>
  </visual>
  <collision>
    <origin
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      rpy="0 0 0" />
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  </collision>
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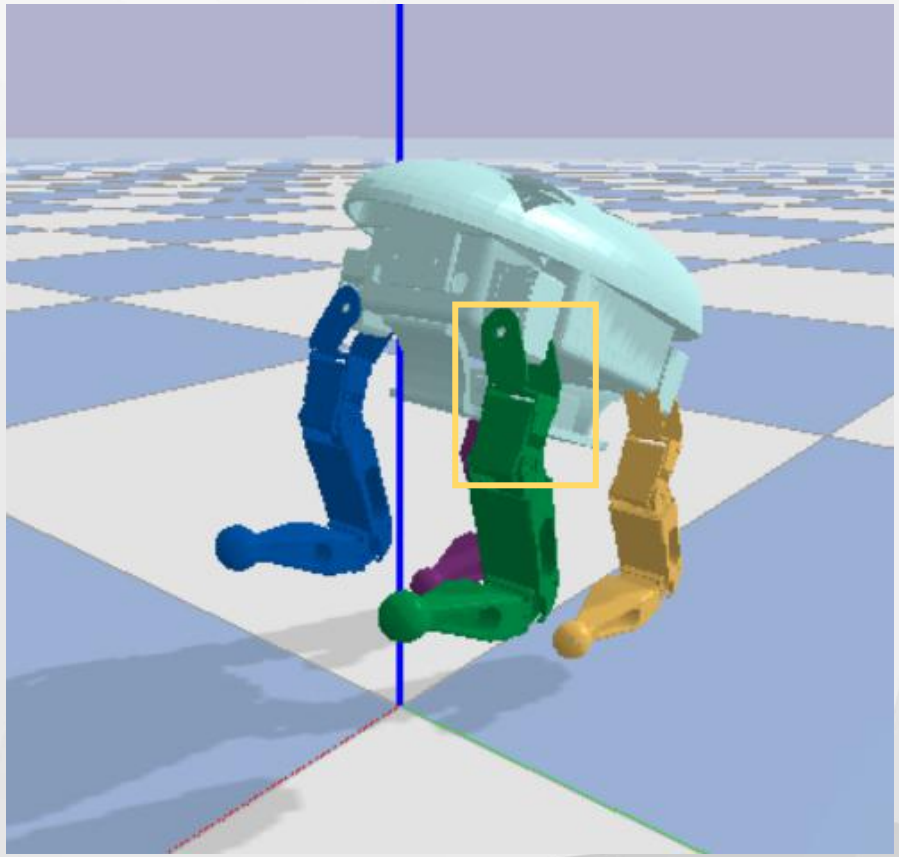
```



- shoulder1 link
- all links include the mass, inertial, collision

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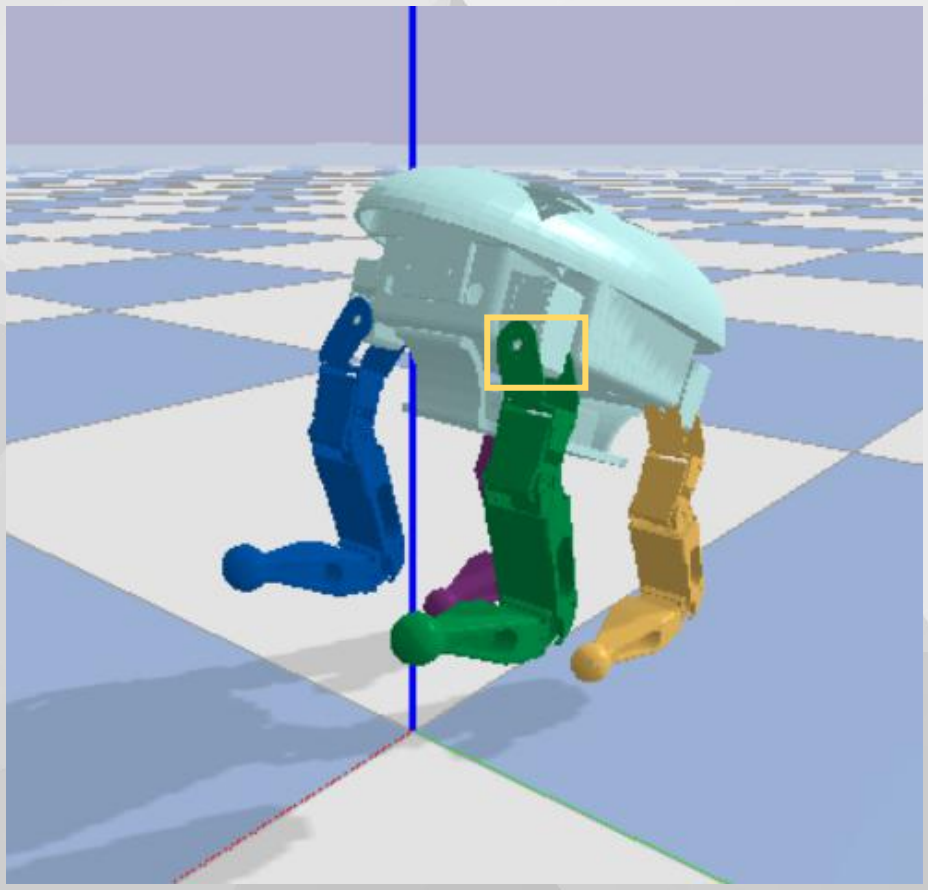
URDF

```
<joint name="body_to_shoulder_1" type="revolute">
  <origin
    xyz="-0.01175 0.085486 -0.0151"
    rpy="0 0 0" />
  <parent link="base_link" />
  <child link="shoulder1" />
  <axis xyz="-1 0 0" />
  <limit effort="1.5" lower="1.08" upper="-1.9" velocity="5.8"/>
</joint>
```



- body and shoulder1 joint
- all joints include limit

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URDF

```
<link name="upper1">
  <inertial>
    <origin
      xyz="0.0746587924570855 -0.0195022828818725 0.00274193692122332"
      rpy="0 0 0" />
    <mass
      value="0.0955394590610938" />
    <inertia
      ixx="2.32575759335115E-05"
      ixy="-4.42904149223622E-07"
      ixz="2.42868778919189E-07"
      iyy="3.34285204091329E-05"
      iyz="-1.50607707657166E-08"
      izz="3.51562967381548E-05" />
  </inertial>
  <visual>
    <origin
      xyz="0 0 0"
      rpy="0 0 0" />
    <geometry>
      <mesh
        filename="package://whole3/meshes/upper1.STL" />
    </geometry>
    <material name="green"/>
  </visual>
  <collision>
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      rpy="0 0 0" />
    <geometry>
      <mesh
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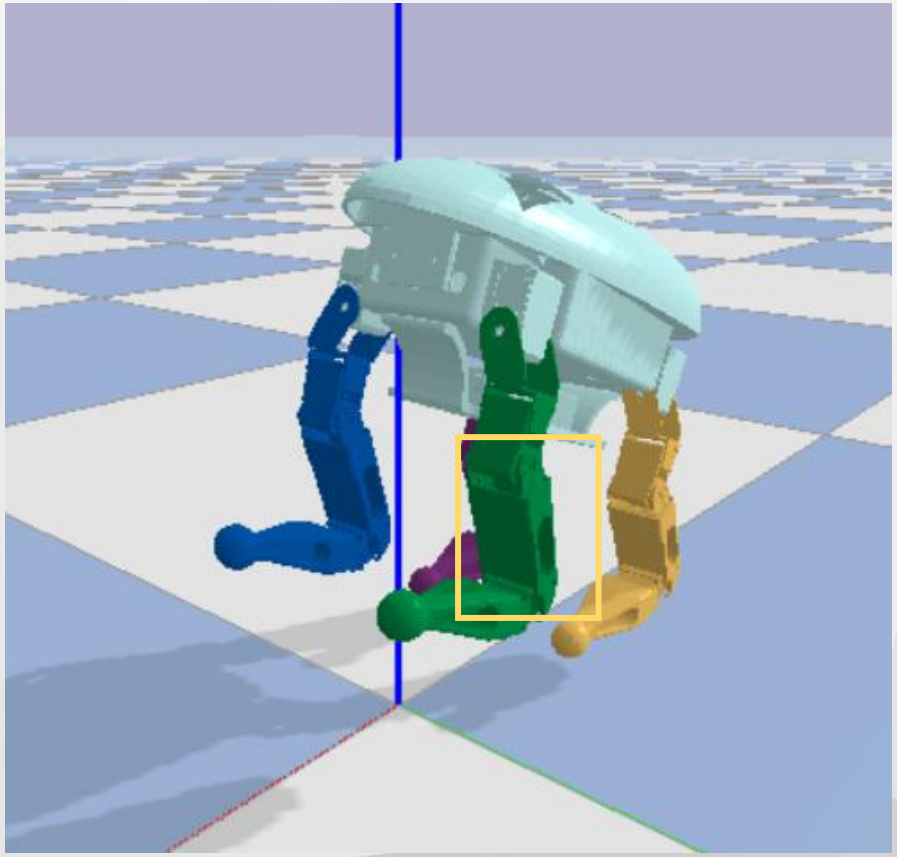
  </collision>
```



- upper1 link
- all links include the mass, inertial, collision

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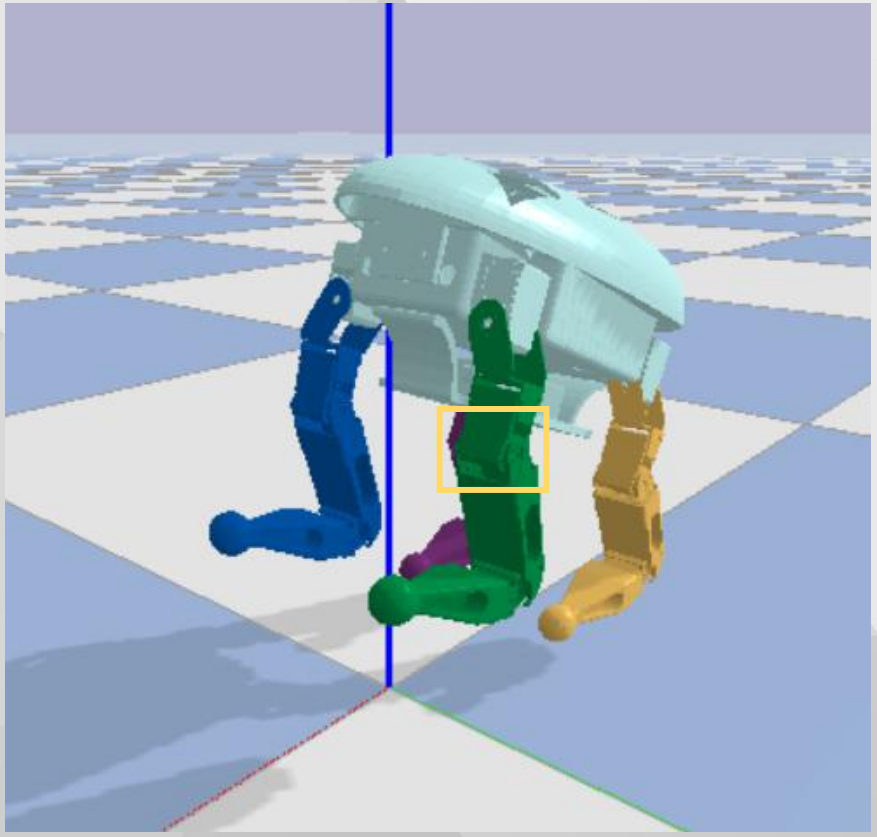
URDF

```
<joint name="shoulder_to_upper_1" type="revolute">
  <origin
    xyz="-0.019986 0.033028 -0.067039"
    rpy="3.1416 -0.011248 -3.1416" />
  <parent link="shoulder1" />
  <child link="upper1" />
  <axis xyz="0 1 0" />
  <limit effort="1.5" lower="0.05" upper="-3.19" velocity="5.8"/>
</joint>
```



- shoulder1 and upper1 link
- all joints include limit

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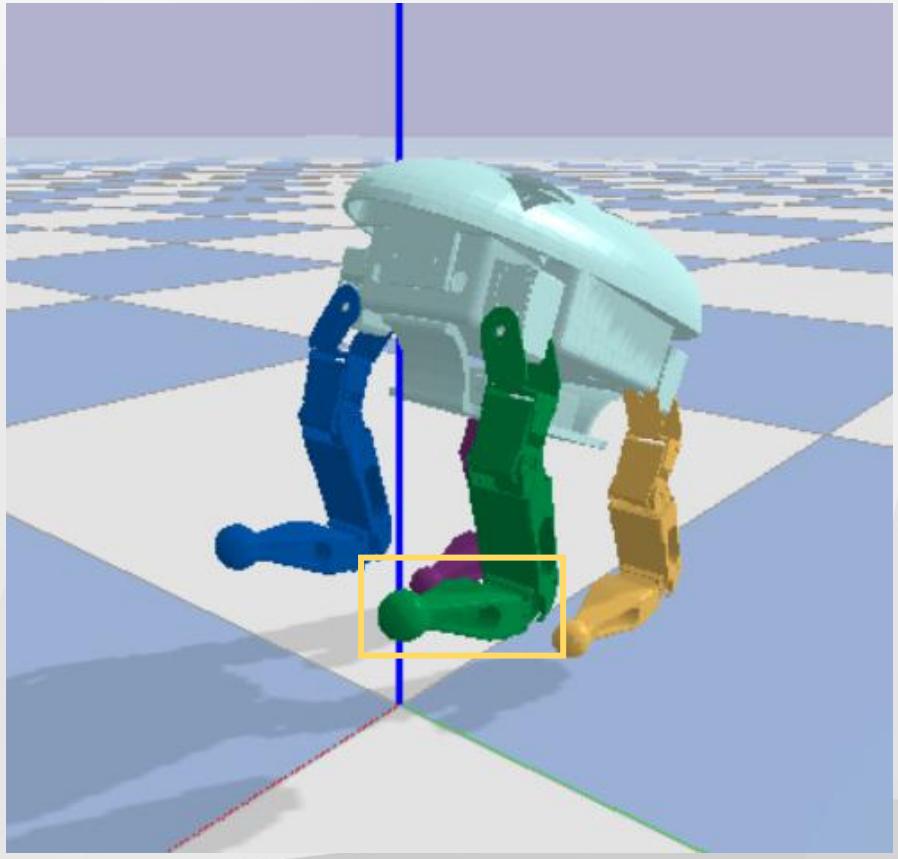
URDF

```
<link name="lower1">
  <inertial>
    <origin
      xyz="0.0602140846319608 -0.0208912726901844 0.000838226306676529"
      rpy="0 0 0" />
    <mass
      value="0.0520137833245092" />
    <inertia
      ixx="8.44391394980476E-06"
      ixy="-6.86193535685136E-09"
      ixz="1.34754783841537E-08"
      iyy="1.55986002096454E-05"
      iyz="-8.55304098100674E-12"
      izz="1.79230959202609E-05" />
  </inertial>
  <visual>
    <origin
      xyz="0 0 0"
      rpy="0 0 0" />
    <geometry>
      <mesh
        filename="package://whole3/meshes/lower1.STL" />
    </geometry>
    <material name="green"/>
  </visual>
  <collision>
    <origin
      xyz="0 0 0"
      rpy="0 0 0" />
    <geometry>
      <mesh
        filename="package://whole3/meshes/lower1.STL" />
    </geometry>
  </collision>
</link>
```



- lower1 link
- all links include the mass, inertial, collision

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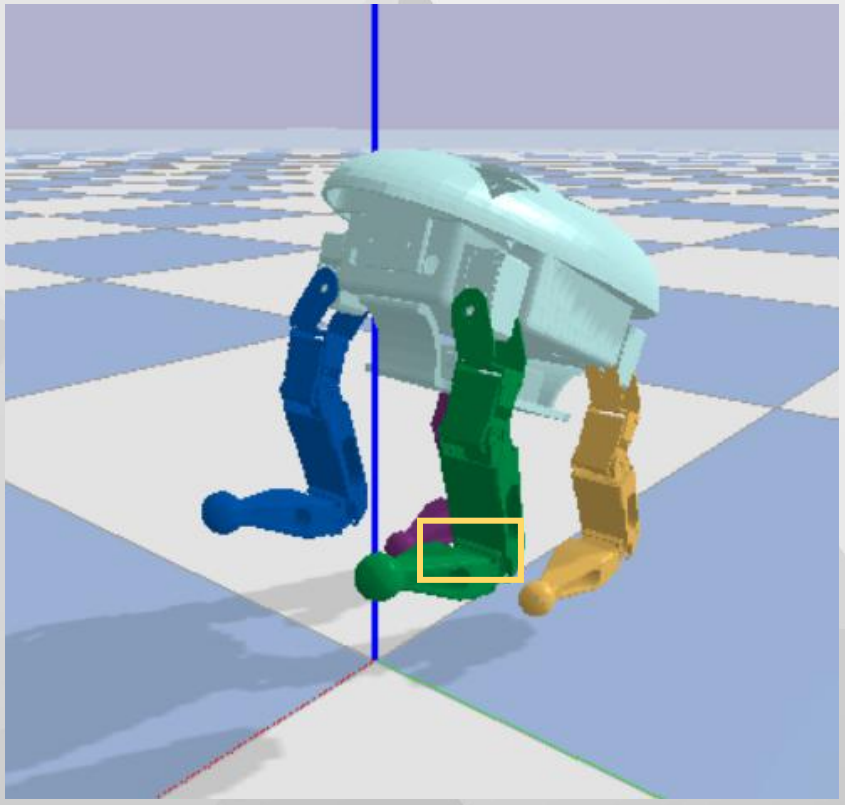
URDF

```
<joint name="upper_to_lower_1" type="revolute">
  <origin
    xyz="0.098736 0.00026 0.021"
    rpy="3.1416 -0.25163 3.1416" />
  <parent link="upper1" />
  <child link="lower1" />
  <axis xyz="0 1 0" />
  <limit effort="1.5" lower="0" upper="2.85" velocity="5.8"/>
</joint>
```



- upper1 and lower1 link
- all joints include limit

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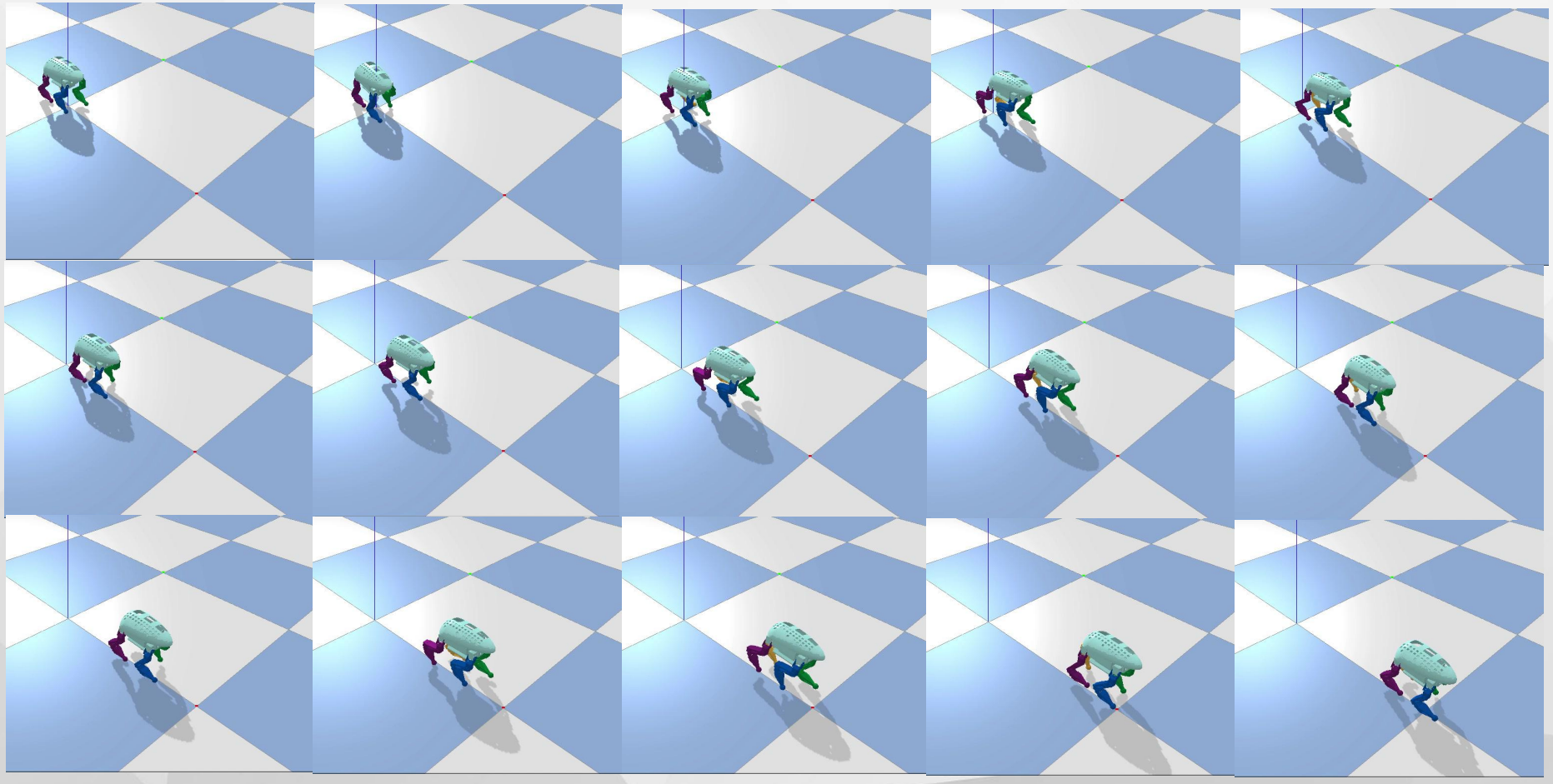
Robot moving



Video Link: https://youtu.be/J5tB9xlCSSs

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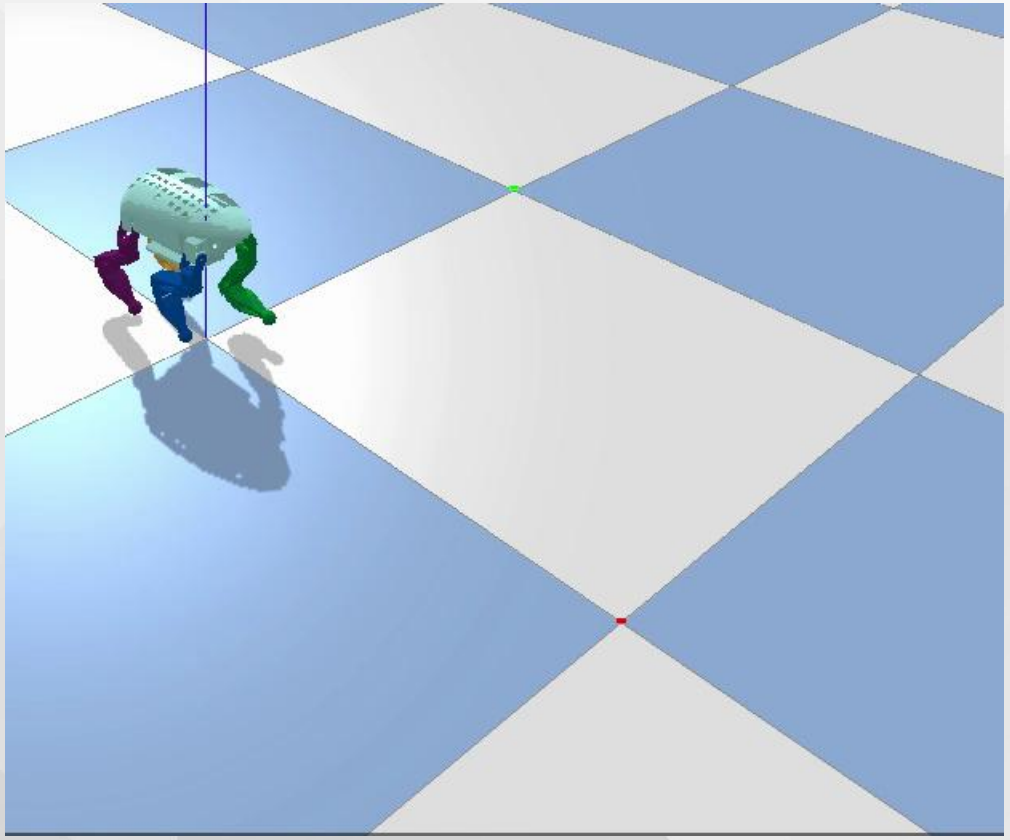

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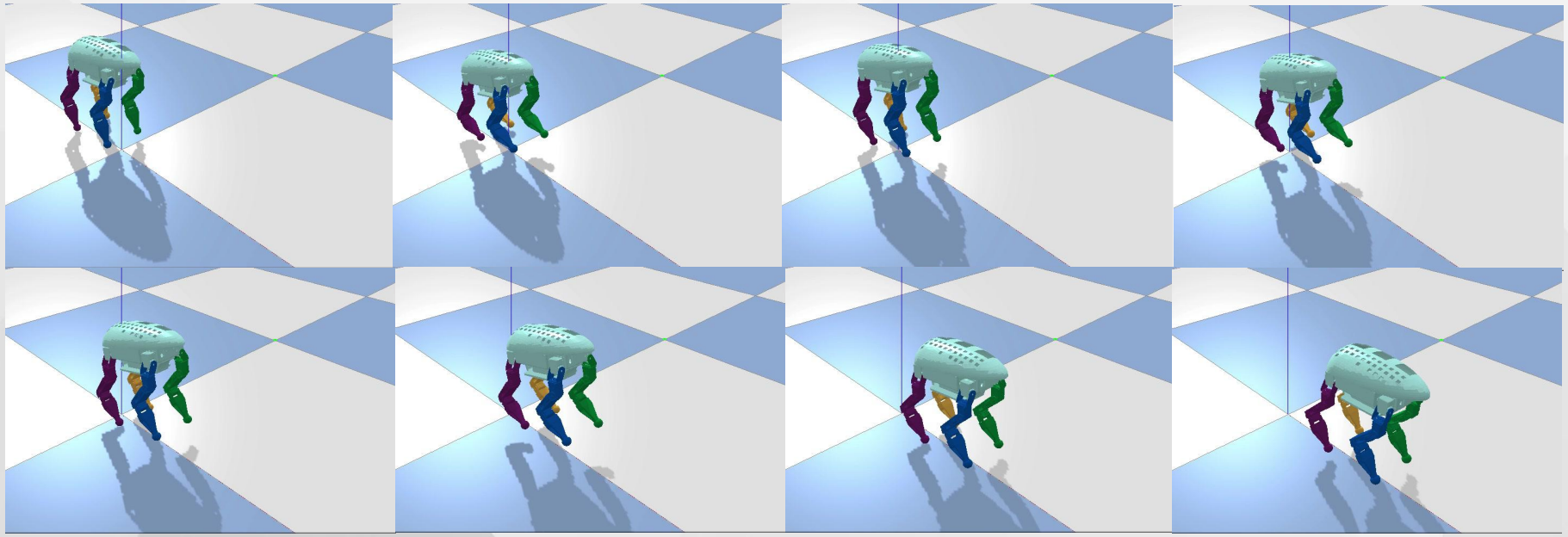
Robot Moving



Video Link: https://youtu.be/50JVZFzIXYo

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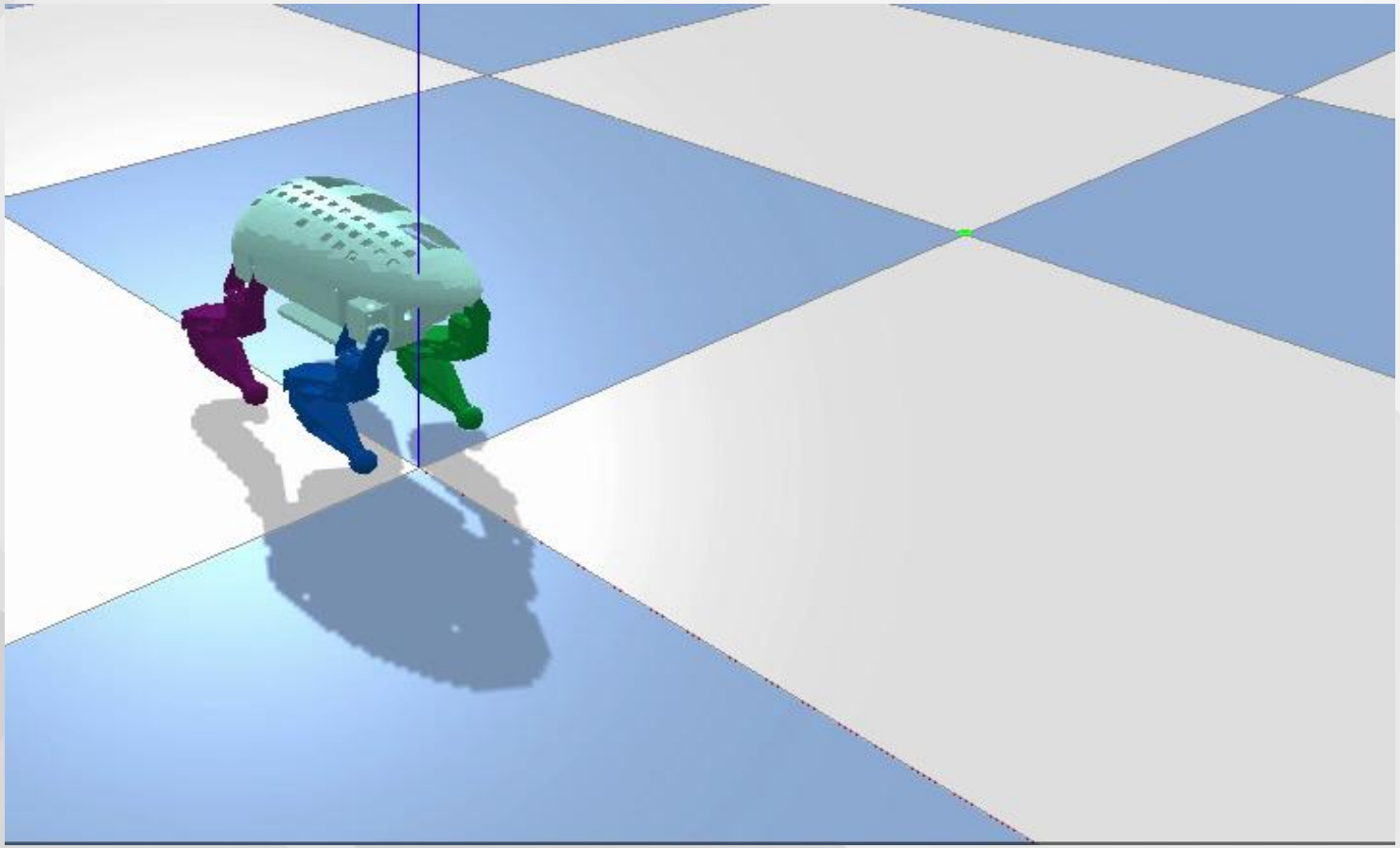

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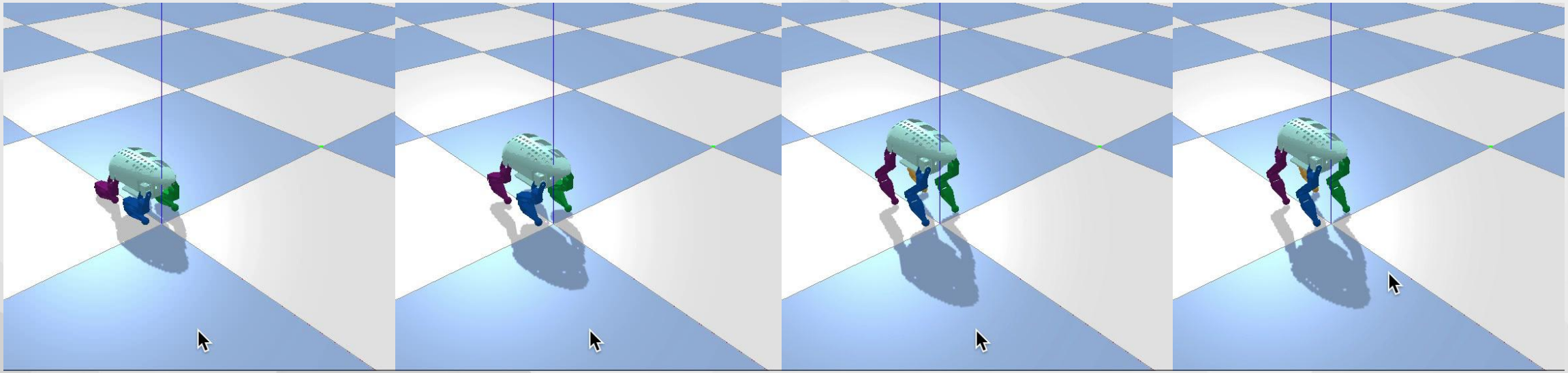
Other locomotion tried - Stand



Video Link: https://youtu.be/E8CqjUwaW_Q

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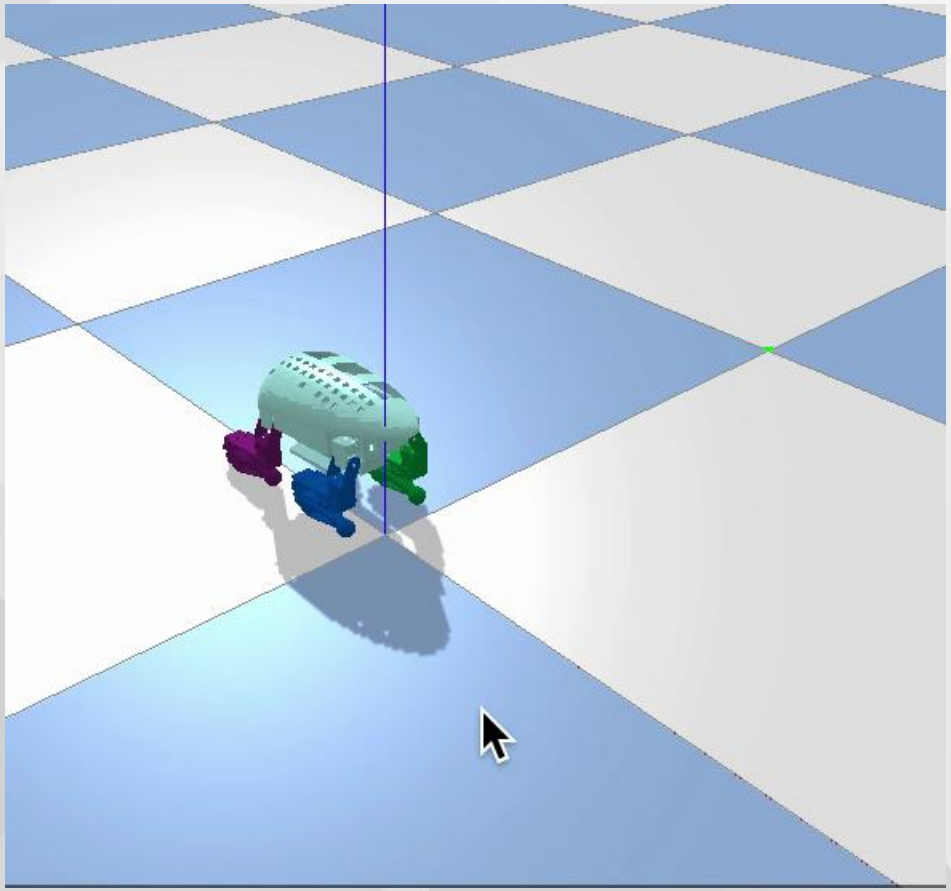

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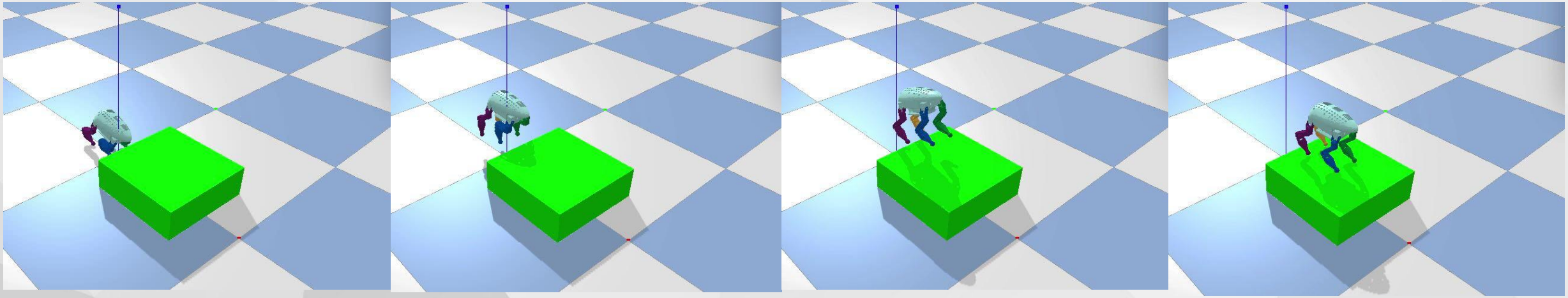
Other environments and goals tried - Jump Gait



Video Link: https://youtu.be/tlzHNgpbAkk

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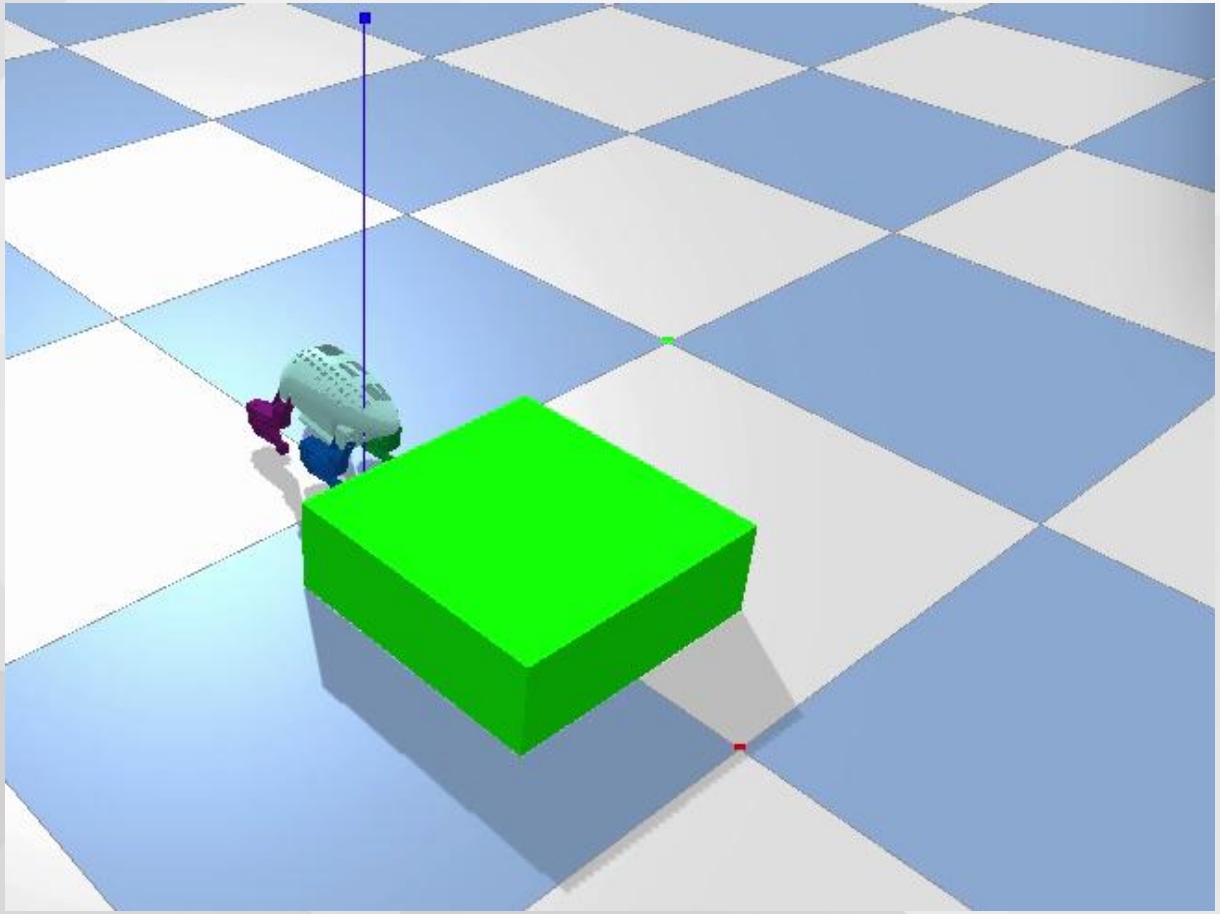

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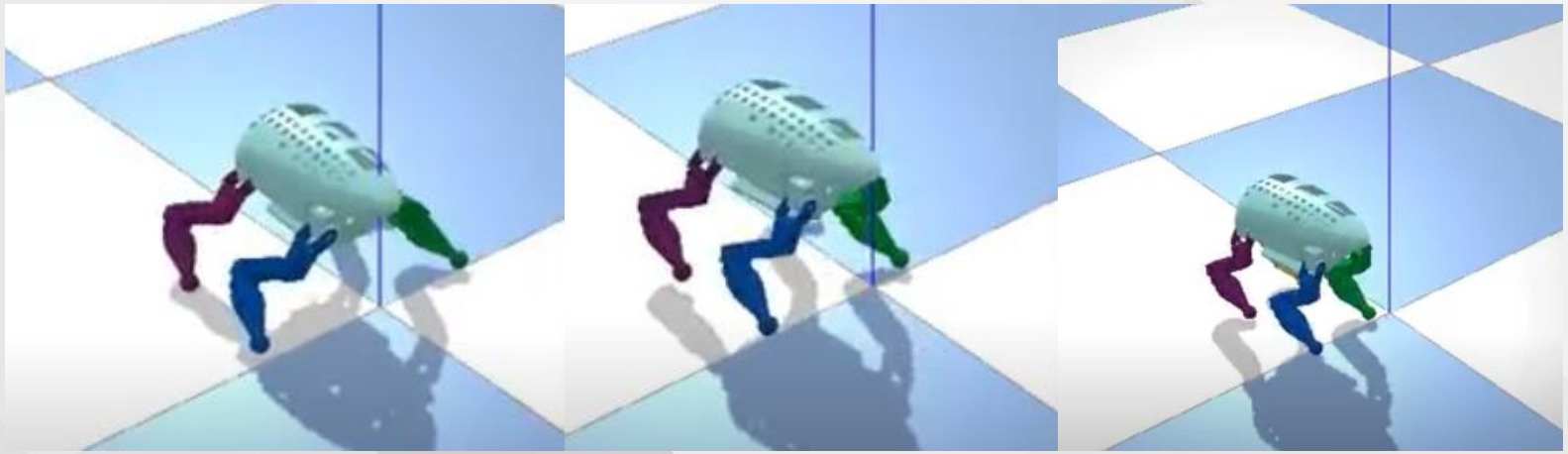
Other environments and goals tried - Do exercise



Video Link: https://www.youtube.com/watch?v=R3OiN1mIO6w&feature=youtu.be

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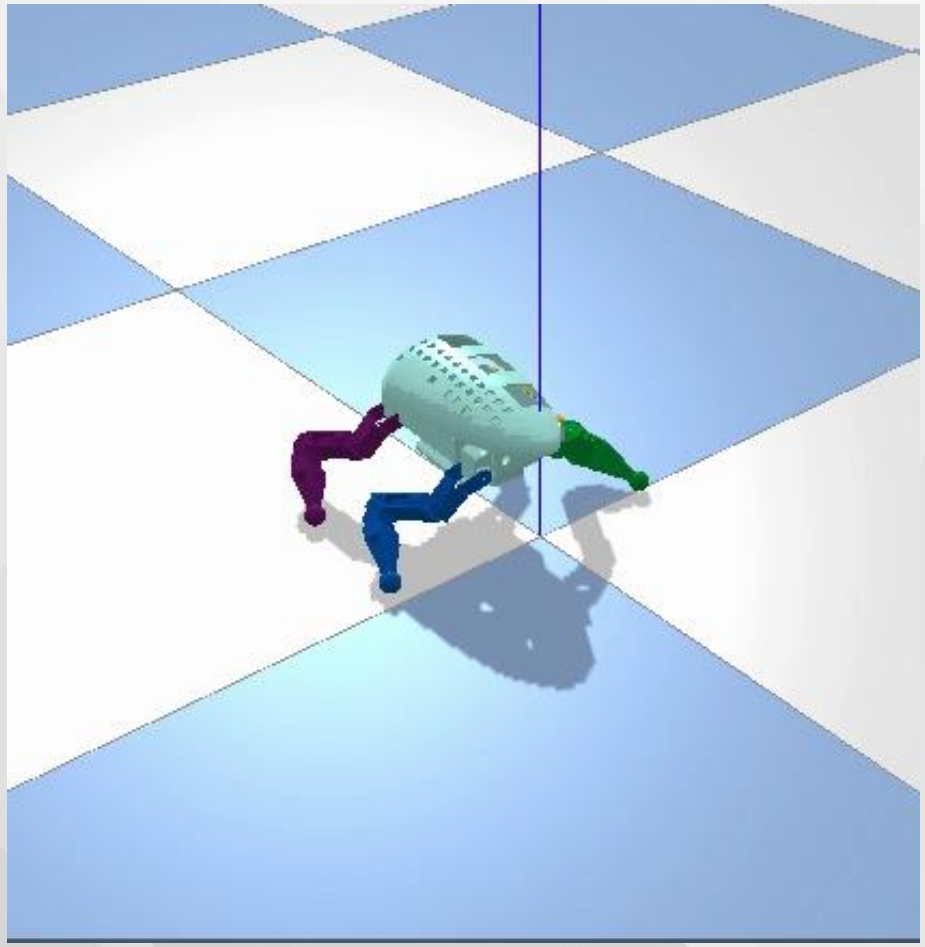

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Other environments and goals tried - Wind

```
sphere = boxId # 100
spherePos, orn = p.getBasePositionAndOrientation(sphere) # 101

force = [5, 0, 0] # 154
p.applyExternalForce(sphere, -1, force, spherePos, flags=p.WORLD_FRAME)
```

Video Link:https://www.youtube.com/watch?v=_U8wy0WWJZg&feature=youtu.be

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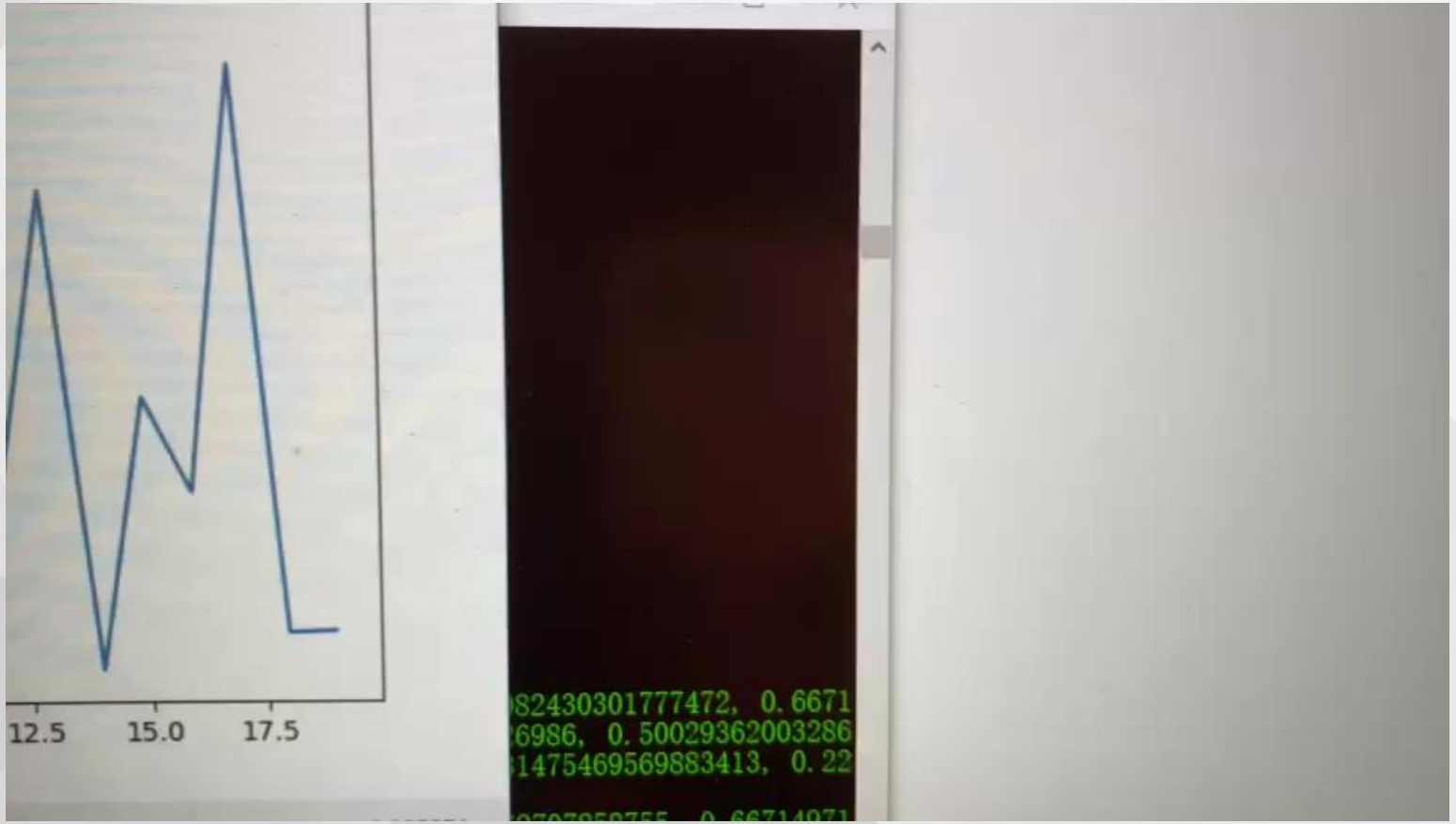

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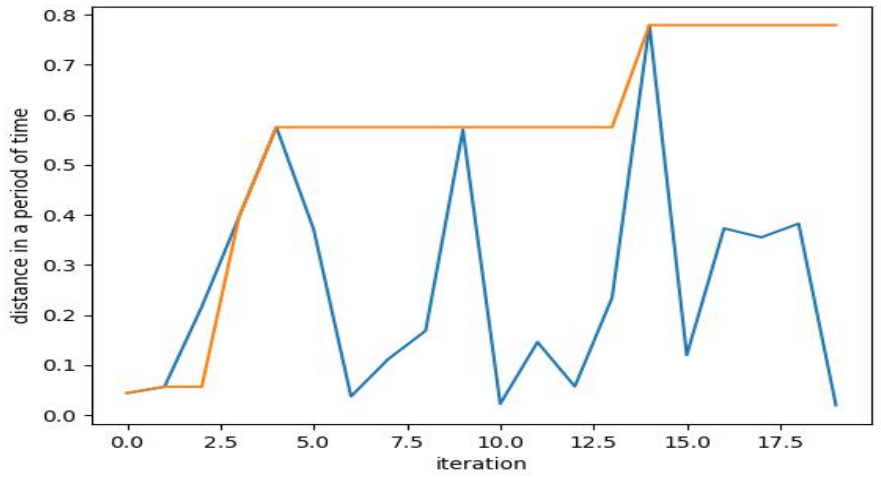
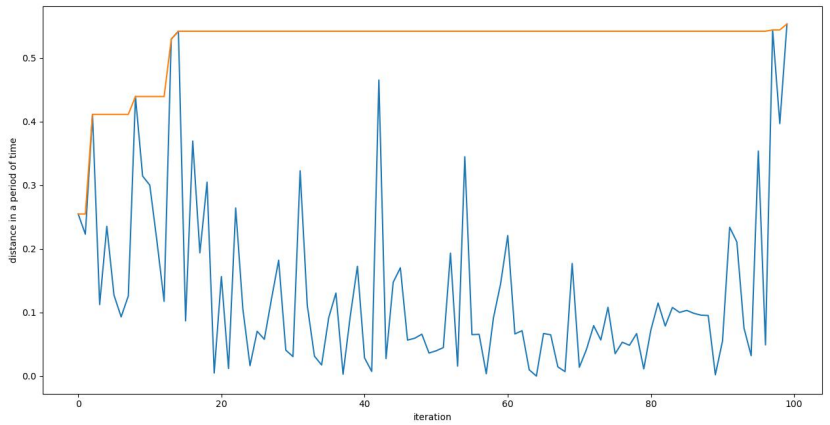
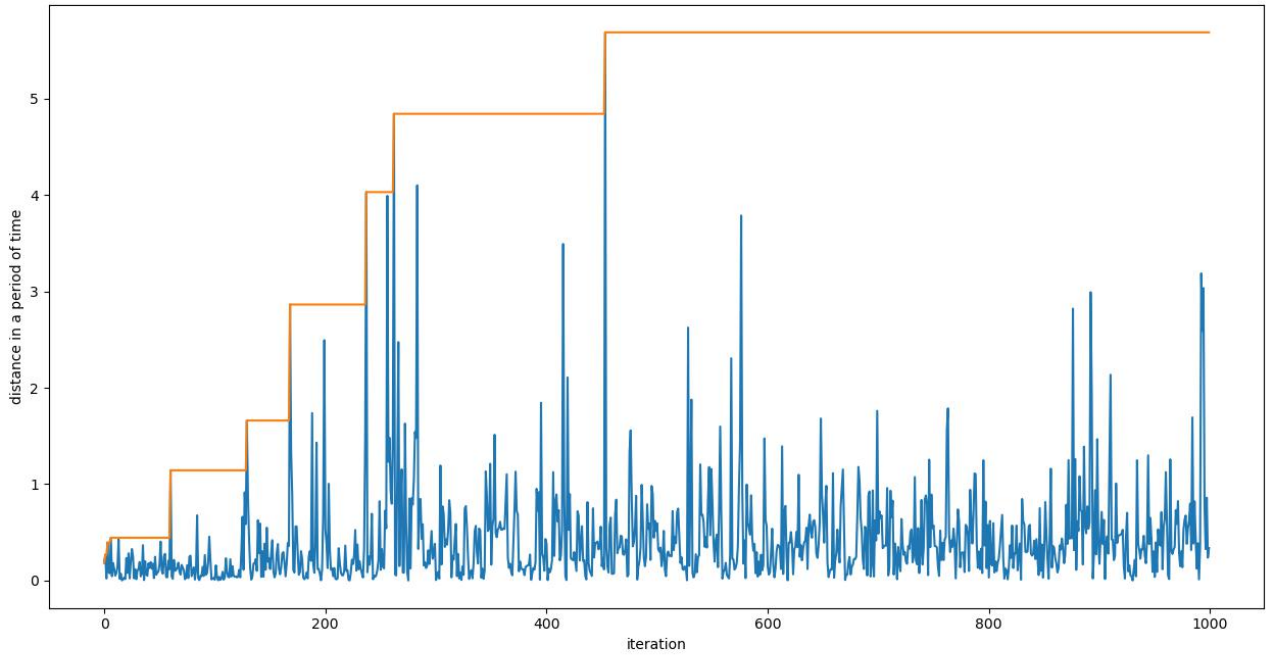
Learning curve - random search







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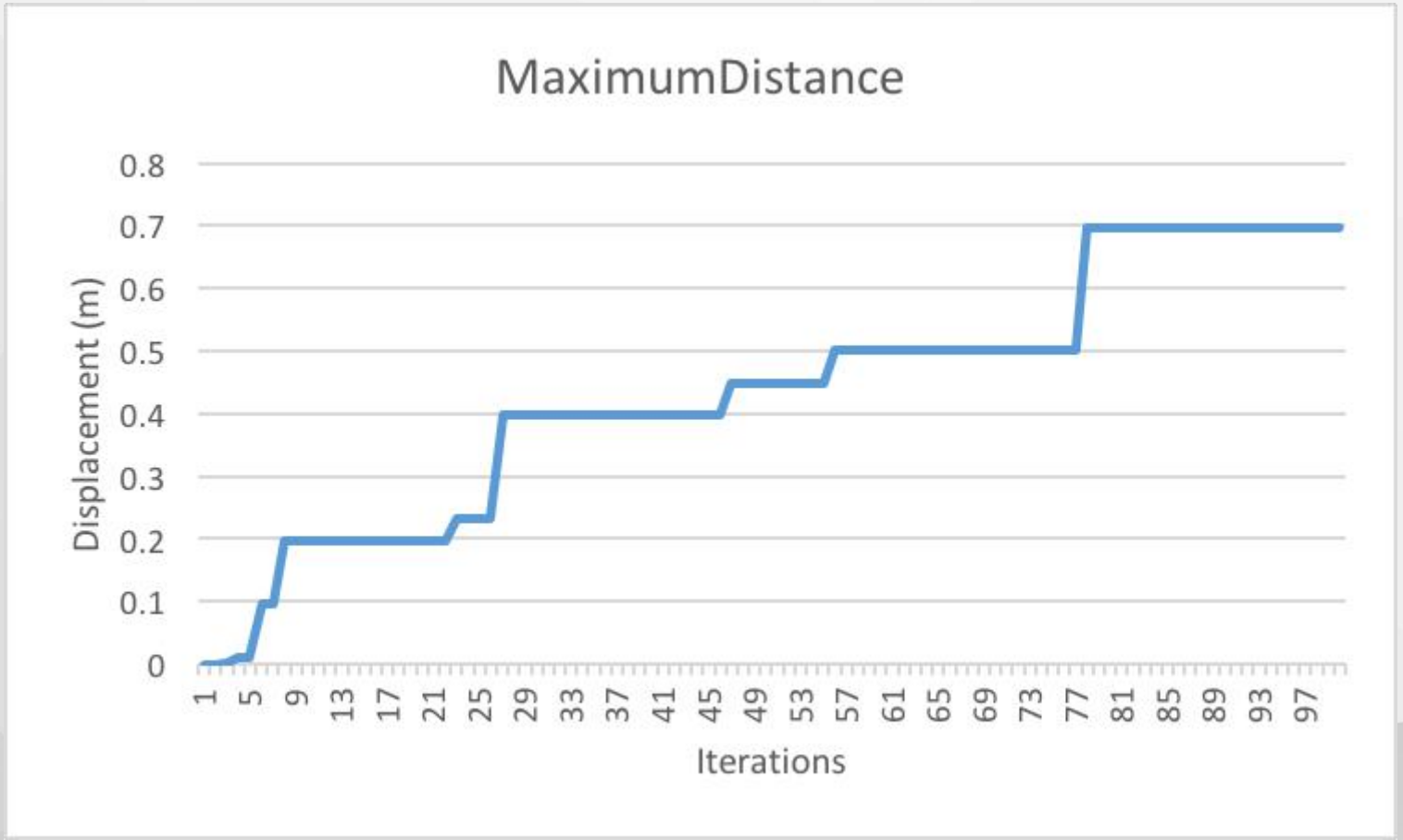
Learning curve - hill climber



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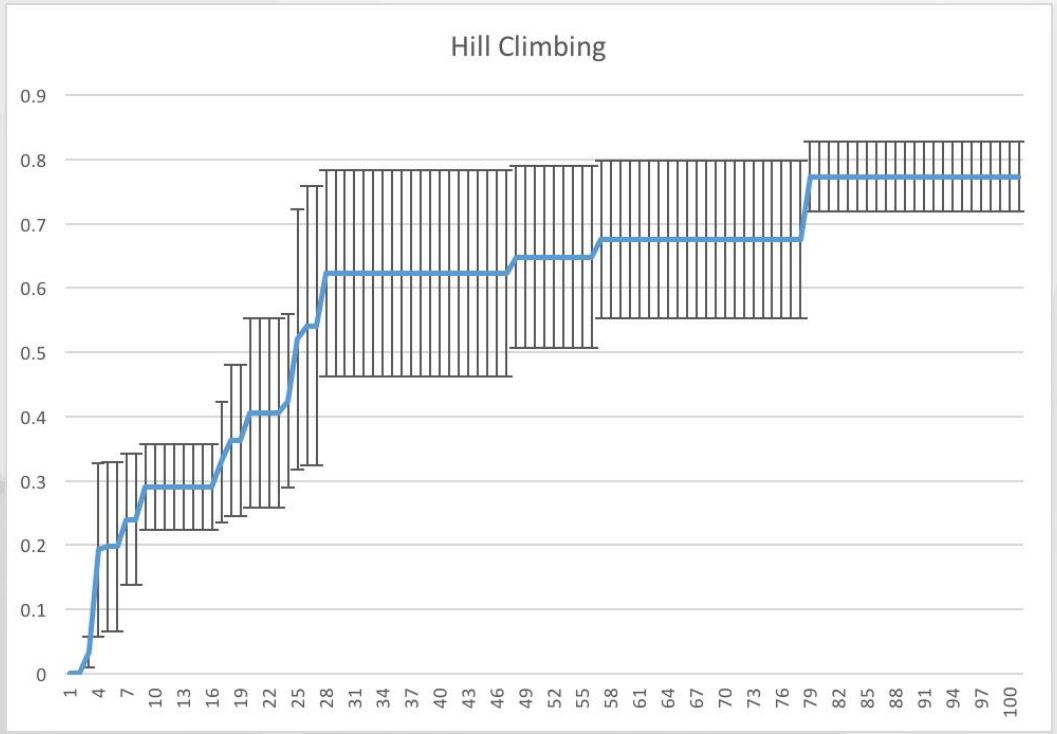
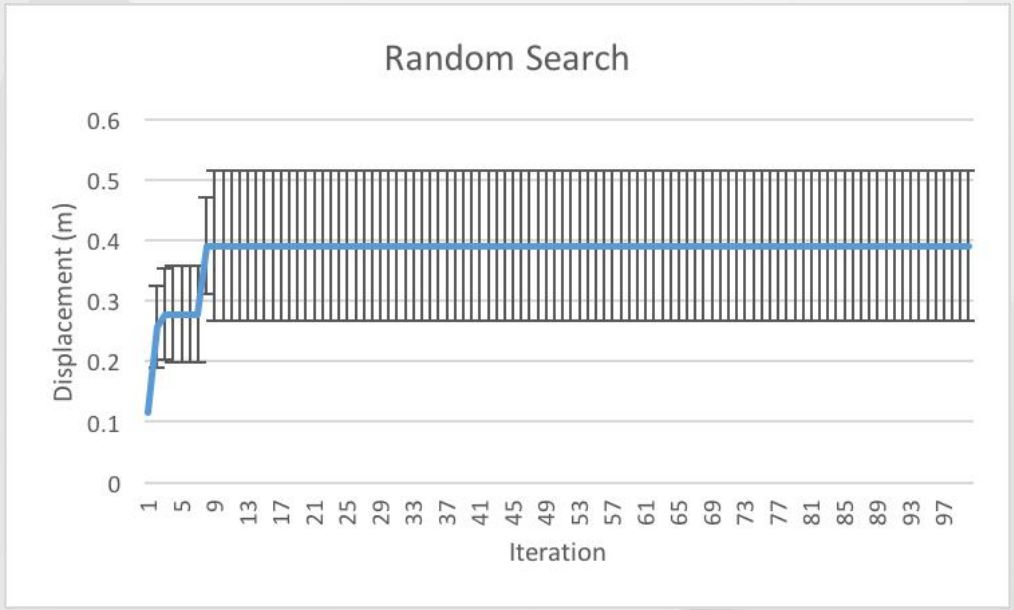
Learning curve error bars





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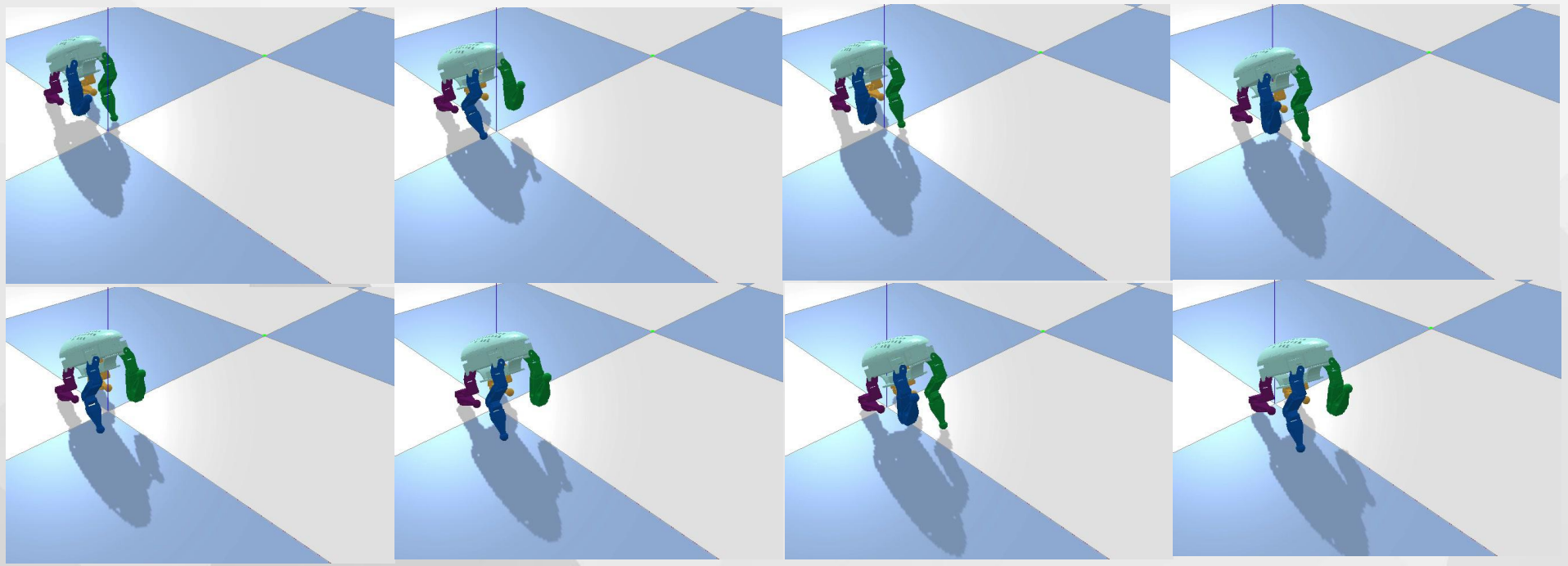
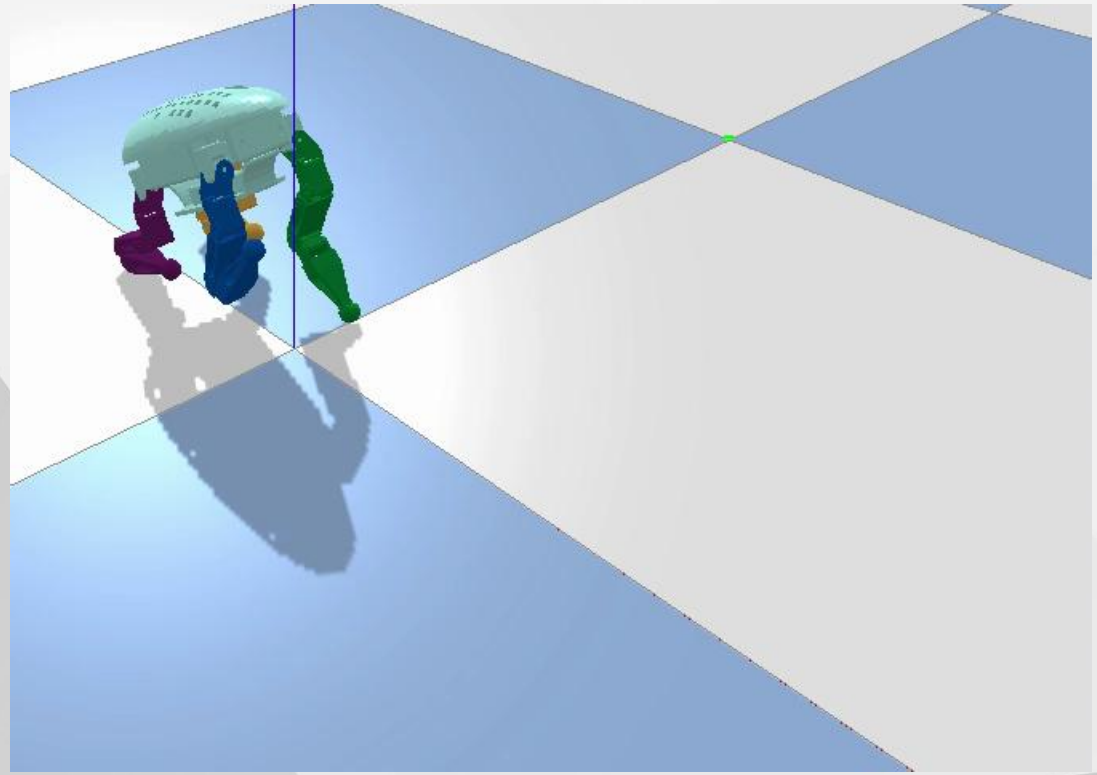
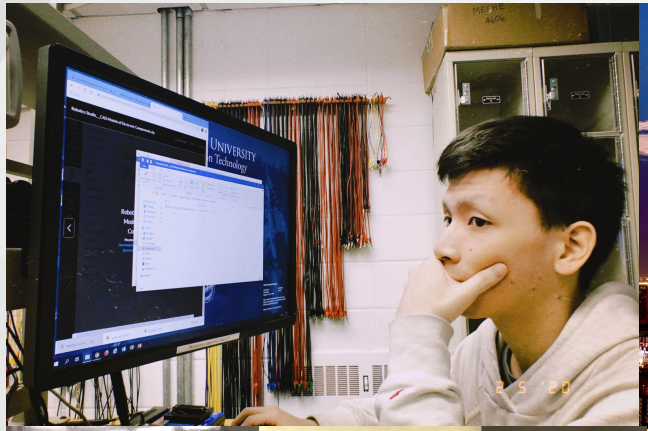
Damage scenarios - Right Rear Leg Disconnected

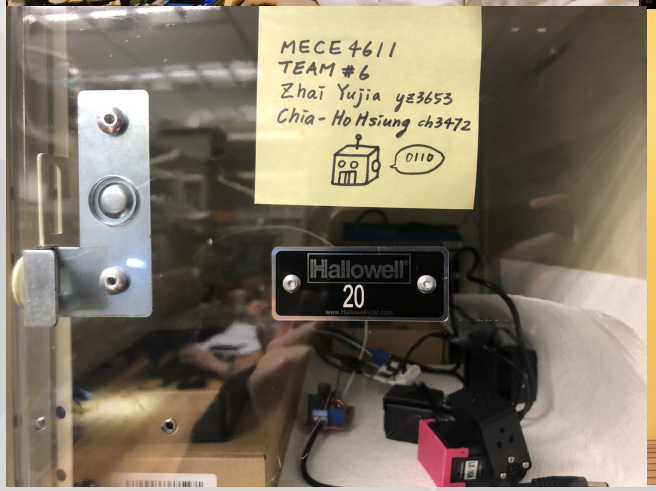


Video Link: https://youtu.be/e_7-mQd2ZXI



Thank you!





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