```
<?xml version="1.0"?>
<sdf version='1.5'>
  <model name='plane'>
    <pose>0 0 5.0 0 0 0</pose>
    <link name='base_link'>
      <pose>0 0 0 0 0 0</pose>
      <inertial>
        <pose>0 0 0 0 0 0</pose>
        <mass>1.7</mass>
        <inertia>
          <ixx>0.73536</ixx>
          <ixy>0</ixy>
          <ixz>0.01436</ixz>
          <iyy>0.16837</iyy>
          <iyz>0</iyz>
          <izz>0.89354</izz>
        </inertia>
      </inertial>
      <collision name='base_link_collision'>
        <pose>0 0 -0.07 0 0 0</pose>
        <geometry>
          <box>
            <size>0.47 0.47 0.11</size>
          </box>
        </geometry>
        <surface>
          <contact>
            <ode>
              <max_vel>10</max_vel>
              <min_depth>0.01</min_depth>
            </ode>
          </contact>
          <!--<friction>
            <ode/>
          </friction>-->
        </surface>
      </collision>
      <visual name='base_link_visual'>
        <pose>0.07 0 -0.08 0 0 0</pose>
        <geometry>
          <mesh>
            <scale>0.1 0.1 0.1</scale>
            <uri>model://plane/meshes/body.dae</uri>
          </mesh>
        </geometry>
        <material>
          <script>
            <name>Gazebo/DarkGrey</name>
            <uri>__default__</uri>
          </script>
        </material>
        <plugin name="left_elevon_lift_visual" filename="libForceVisual.so">
```

```
      <topic_name>lift_force/lumped_force</topic_name>
      <color>Gazebo/Green</color>
    </plugin>
  </visual>
  <gravity>1</gravity>
  <velocity_decay/>
  <self_collide>0</self_collide>
</link>
<link name='plane/imu_link'>
  <pose>0 0 0 0 0 0</pose>
  <inertial>
    <pose>0 0 0 0 0 0</pose>
    <mass>0.015</mass>
    <inertia>
      <ixx>1e-05</ixx>
      <ixy>0</ixy>
      <ixz>0</ixz>
      <iyy>1e-05</iyy>
      <iyz>0</iyz>
      <izz>1e-05</izz>
    </inertia>
  </inertial>
</link>
<joint name='plane/imu_joint' type='revolute'>
  <child>plane/imu_link</child>
  <parent>base_link</parent>
  <axis>
    <xyz>1 0 0</xyz>
    <limit>
      <lower>0</lower>
      <upper>0</upper>
      <effort>0</effort>
      <velocity>0</velocity>
    </limit>
    <dynamics>
      <spring_reference>0</spring_reference>
      <spring_stiffness>0</spring_stiffness>
    </dynamics>
    <use_parent_model_frame>1</use_parent_model_frame>
  </axis>
</joint>
<include>
  <uri>model://airspeed</uri>
  <pose>0 0 0 0 0 0</pose>
  <name>airspeed</name>
</include>
<joint name='airspeed_joint' type='fixed'>
  <child>airspeed::link</child>
  <parent>base_link</parent>
</joint>
<link name='rotor_puller'>
  <pose>0.30 0 0.025 0 1.570796 0</pose>
```

```
  <inertial>
    <pose>0 0 0 0 0 0</pose>
    <mass>0.120</mass>
    <inertia>
      <ixx>1.0e-05</ixx>
      <ixy>0</ixy>
      <ixz>0</ixz>
      <iyy>0.00023</iyy>
      <iyz>0</iyz>
      <izz>0.00023</izz>
    </inertia>
  </inertial>
  <collision name='rotor_puller_collision'>
    <pose>0.0 0 0.0 0 0 0</pose>
    <geometry>
      <cylinder>
        <length>0.046</length>
        <radius>0.013</radius>
      </cylinder>
    </geometry>
    <surface>
      <contact>
        <ode/>
      </contact>
      <friction>
        <ode/>
      </friction>
    </surface>
  </collision>
  <visual name='rotor_puller_visual'>
    <pose>0 0 -0.09 0 0 0</pose>
    <geometry>
      <mesh>
        <scale>1 1 1</scale>
        <uri>model://plane/meshes/iris_prop_ccw.dae</uri>
      </mesh>
    </geometry>
    <material>
      <script>
        <name>Gazebo/Blue</name>
        <uri>__default__</uri>
      </script>
    </material>
  </visual>
  <gravity>1</gravity>
  <velocity_decay/>
  <self_collide>0</self_collide>
</link>
<joint name='rotor_puller_joint' type='revolute'>
  <child>rotor_puller</child>
  <parent>base_link</parent>
  <axis>
```

```
    <xyz>1 0 0</xyz>
    <limit>
      <lower>-1e+16</lower>
      <upper>1e+16</upper>
    </limit>
    <dynamics>
      <spring_reference>0</spring_reference>
      <spring_stiffness>0</spring_stiffness>
    </dynamics>
    <use_parent_model_frame>1</use_parent_model_frame>
  </axis>
</joint>

<link name="left_elevon">
  <inertial>
    <mass>0.00000001</mass>
    <inertia>
      <ixx>0.000001</ixx>
      <ixy>0.0</ixy>
      <iyy>0.000001</iyy>
      <ixz>0.0</ixz>
      <iyz>0.0</iyz>
      <izz>0.000001</izz>
    </inertia>
    <pose>0 0.3 0 0.00 0 0.0</pose>
  </inertial>
  <visual name='left_elevon_visual'>
    <pose>0.07 0.0 -0.08 0.00 0 0.0</pose>
    <geometry>
      <mesh>
        <scale>0.1 0.1 0.1</scale>
        <uri>model://plane/meshes/left_aileron.dae</uri>
      </mesh>
    </geometry>
    <material>
      <script>
        <name>Gazebo/Red</name>
        <uri>__default__</uri>
      </script>
    </material>
  </visual>
</link>
<link name="right_elevon">
  <inertial>
    <mass>0.00000001</mass>
    <inertia>
      <ixx>0.000001</ixx>
      <ixy>0.0</ixy>
      <iyy>0.000001</iyy>
      <ixz>0.0</ixz>
      <iyz>0.0</iyz>
      <izz>0.000001</izz>
```

```
    </inertia>
    <pose>0 -0.3 0 0.00 0 0.0</pose>
  </inertial>
  <visual name='right_elevon_visual'>
    <pose>0.07 0.0 -0.08 0.00 0 0.0</pose>
    <geometry>
      <mesh>
        <scale>0.1 0.1 0.1</scale>
        <uri>model://plane/meshes/right_aileron.dae</uri>
      </mesh>
    </geometry>
    <material>
      <script>
        <name>Gazebo/Red</name>
        <uri>__default__</uri>
      </script>
    </material>
  </visual>
</link>
<link name="left_flap">
  <inertial>
    <mass>0.00000001</mass>
    <inertia>
      <ixx>0.000001</ixx>
      <ixy>0.0</ixy>
      <iyy>0.000001</iyy>
      <ixz>0.0</ixz>
      <iyz>0.0</iyz>
      <izz>0.000001</izz>
    </inertia>
    <pose>0 0.15 0 0.00 0 0.0</pose>
  </inertial>
  <visual name='left_flap_visual'>
    <pose>0.07 0.0 -0.08 0.00 0 0.0</pose>
    <geometry>
      <mesh>
        <scale>0.1 0.1 0.1</scale>
        <uri>model://plane/meshes/left_flap.dae</uri>
      </mesh>
    </geometry>
    <material>
      <script>
        <name>Gazebo/Red</name>
        <uri>__default__</uri>
      </script>
    </material>
  </visual>
</link>
<link name="right_flap">
  <inertial>
    <mass>0.00000001</mass>
    <inertia>
```

```
      <ixx>0.000001</ixx>
      <ixy>0.0</ixy>
      <iyy>0.000001</iyy>
      <ixz>0.0</ixz>
      <iyz>0.0</iyz>
      <izz>0.000001</izz>
    </inertia>
    <pose>0 -0.15 0 0.00 0 0.0</pose>
  </inertial>
  <visual name='right_flap_visual'>
    <pose>0.07 0.0 -0.08 0.00 0 0.0</pose>
    <geometry>
      <mesh>
        <scale>0.1 0.1 0.1</scale>
        <uri>model://plane/meshes/right_flap.dae</uri>
      </mesh>
    </geometry>
    <material>
      <script>
        <name>Gazebo/Red</name>
        <uri>__default__</uri>
      </script>
    </material>
  </visual>
</link>
<link name="elevator">
  <inertial>
    <mass>0.00000001</mass>
    <inertia>
      <ixx>0.000001</ixx>
      <ixy>0.0</ixy>
      <iyy>0.000001</iyy>
      <ixz>0.0</ixz>
      <iyz>0.0</iyz>
      <izz>0.000001</izz>
    </inertia>
    <pose> -0.5 0 0 0.00 0 0.0</pose>
  </inertial>
  <visual name='elevator_visual'>
    <pose>0.07 0.0 -0.08 0.00 0 0.0</pose>
    <geometry>
      <mesh>
        <scale>0.1 0.1 0.1</scale>
        <uri>model://plane/meshes/elevators.dae</uri>
      </mesh>
    </geometry>
    <material>
      <script>
        <name>Gazebo/Red</name>
        <uri>__default__</uri>
      </script>
    </material>
```

```
  </visual>
</link>
<link name="rudder">
  <inertial>
    <mass>0.00000001</mass>
    <inertia>
      <ixx>0.000001</ixx>
      <ixy>0.0</ixy>
      <iyy>0.000001</iyy>
      <ixz>0.0</ixz>
      <iyz>0.0</iyz>
      <izz>0.000001</izz>
    </inertia>
    <pose>-0.5 0 0.05 0 0 0 </pose>
  </inertial>
  <visual name='rudder_visual'>
    <pose>0.07 0.0 -0.08 0.00 0 0.0</pose>
    <geometry>
      <mesh>
        <scale>0.1 0.1 0.1</scale>
        <uri>model://plane/meshes/rudder.dae</uri>
      </mesh>
    </geometry>
    <material>
      <script>
        <name>Gazebo/Red</name>
        <uri>__default__</uri>
      </script>
    </material>
  </visual>
</link>
<joint name='left_elevon_joint' type='revolute'>
  <parent>base_link</parent>
  <child>left_elevon</child>
  <pose>-0.07 0.4 0.08 0.00 0 0.0</pose>
  <axis>
    <xyz>0 1 0</xyz>
    <limit>
      <!-- -30/+30 deg. -->
      <lower>-0.53</lower>
      <upper>0.53</upper>
    </limit>
    <dynamics>
      <damping>1.000</damping>
    </dynamics>
  </axis>
  <physics>
    <ode>
      <implicit_spring_damper>1</implicit_spring_damper>
    </ode>
  </physics>
</joint>
```

```
<joint name='right_elevon_joint' type='revolute'>
  <parent>base_link</parent>
  <child>right_elevon</child>
  <pose>-0.07 -0.4 0.08 0.00 0 0.0</pose>
  <axis>
    <xyz>0 1 0</xyz>
    <limit>
      <!-- -30/+30 deg. -->
      <lower>-0.53</lower>
      <upper>0.53</upper>
    </limit>
    <dynamics>
      <damping>1.000</damping>
    </dynamics>
  </axis>
  <physics>
    <ode>
      <implicit_spring_damper>1</implicit_spring_damper>
    </ode>
  </physics>
</joint>
<joint name='left_flap_joint' type='revolute'>
  <parent>base_link</parent>
  <child>left_flap</child>
  <pose>-0.07 0.2 0.08 0.00 0 0.0</pose>
  <axis>
    <xyz>0 1 0</xyz>
    <limit>
      <!-- -30/+30 deg. -->
      <lower>-0.53</lower>
      <upper>0.53</upper>
    </limit>
    <dynamics>
      <damping>1.000</damping>
    </dynamics>
  </axis>
  <physics>
    <ode>
      <implicit_spring_damper>1</implicit_spring_damper>
    </ode>
  </physics>
</joint>
<joint name='right_flap_joint' type='revolute'>
  <parent>base_link</parent>
  <child>right_flap</child>
  <pose>-0.07 -0.2 0.08 0.00 0 0.0</pose>
  <axis>
    <xyz>0 1 0</xyz>
    <limit>
      <!-- -30/+30 deg. -->
      <lower>-0.53</lower>
      <upper>0.53</upper>
```

```
    </limit>
    <dynamics>
      <damping>1.000</damping>
    </dynamics>
  </axis>
  <physics>
    <ode>
      <implicit_spring_damper>1</implicit_spring_damper>
    </ode>
  </physics>
</joint>
<joint name='elevator_joint' type='revolute'>
  <parent>base_link</parent>
  <child>elevator</child>
  <pose> -0.5 0 0 0 0 0</pose>
  <axis>
    <xyz>0 1 0</xyz>
    <limit>
      <!-- -30/+30 deg. -->
      <lower>-0.53</lower>
      <upper>0.53</upper>
    </limit>
    <dynamics>
      <damping>1.000</damping>
    </dynamics>
  </axis>
  <physics>
    <ode>
      <implicit_spring_damper>1</implicit_spring_damper>
    </ode>
  </physics>
</joint>
<joint name='rudder_joint' type='revolute'>
  <parent>base_link</parent>
  <child>rudder</child>
  <pose>-0.5 0 0.05 0.00 0 0.0</pose>
  <axis>
    <xyz>0 0 1</xyz>
    <limit>
      <!-- -30/+30 deg. -->
      <lower>-0.53</lower>
      <upper>0.53</upper>
    </limit>
    <dynamics>
      <damping>1.000</damping>
    </dynamics>
  </axis>
  <physics>
    <ode>
      <implicit_spring_damper>1</implicit_spring_damper>
    </ode>
  </physics>
```

```
</joint>
<include>
  <uri>model://gps</uri>
  <pose>0 0 0 0 0 0</pose>
  <name>gps</name>
</include>
<joint name='gps_joint' type='fixed'>
  <child>gps::link</child>
  <parent>base_link</parent>
</joint>
<plugin name="aircraft" filename="libAdvancedLiftDragPlugin.so">
  <a0>0.0</a0>
  <CL0>0.25069</CL0>
  <AR>19.081</AR>
  <eff>0.979</eff>
  <CLa>5.959</CLa>
  <CD0>0.00905</CD0>
  <Cem0>-0.0651</Cem0>
  <Cema>-1.466771956</Cema>
  <CYb>-0.29</CYb>
  <Cellb>-0.15</Cellb>
  <Cenb>0.05</Cenb>
  <CDp>0.0</CDp>
  <CYp>-0.28</CYp>
  <CLp>0.0</CLp>
  <Cellp>-0.64</Cellp>
  <Cemp>0.0</Cemp>
  <Cenp>-0.036</Cenp>
  <CDq>0.192</CDq>
  <CYq>0.0</CYq>
  <CLq>9.1</CLq>
  <Cellq>0.0</Cellq>
  <Cemq>-22.68</Cemq>
  <Cenq>0.0</Cenq>
  <CDr>0.0</CDr>
  <CYr>0.1775</CYr>
  <CLr>0.0</CLr>
  <Cellr>0.092</Cellr>
  <Cemr>0.0</Cemr>
  <Cenr>-0.0432</Cenr>
  <alpha_stall>0.20943951</alpha_stall>
  <CLa_stall>-3.85</CLa_stall>
  <CDa_stall>-0.9233984055</CDa_stall>
  <Cema_stall>0</Cema_stall>
  <ref_pt>-0.12 0.0 0.0</ref_pt>
  <area>0.7971</area>
  <mac>0.2175</mac>
  <air_density>1.2225</air_density>
  <forward>1 0 0</forward>
  <upward>0 0 1</upward>
  <link_name>base_link</link_name>
  <topic_name>lift_force/lumped_force</topic_name> <!--Uncomment to draw the force-->
```

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  <num_ctrl_surfaces>4</num_ctrl_surfaces>
  <control_surface>
    <name>left_elevon_joint</name>
    <index>0</index>
    <direction>1</direction>
    <CD_ctrl>-0.002893437</CD_ctrl>
    <CY_ctrl>0.012547776</CY_ctrl>
    <CL_ctrl>-0.349762086</CL_ctrl>
    <Cell_ctrl>-0.06869764</Cell_ctrl>
    <Cem_ctrl>0.025467974</Cem_ctrl>
    <Cen_ctrl>-0.004297183</Cen_ctrl>
  </control_surface>
  <control_surface>
    <name>right_elevon_joint</name>
    <direction>1</direction>
    <index>1</index>
    <CD_ctrl>-0.002893437</CD_ctrl>
    <CY_ctrl>-0.012547776</CY_ctrl>
    <CL_ctrl>-0.349762086</CL_ctrl>
    <Cell_ctrl>0.06869764</Cell_ctrl>
    <Cem_ctrl>0.025467974</Cem_ctrl>
    <Cen_ctrl>0.004297183</Cen_ctrl>
  </control_surface>
  <control_surface>
    <name>elevator_joint</name>
    <direction>-1</direction>
    <index>2</index>
    <CD_ctrl>0.006990085</CD_ctrl>
    <CY_ctrl>0.303168015</CY_ctrl>
    <CL_ctrl>0.303168015</CL_ctrl>
    <Cell_ctrl>-0.256819731</Cell_ctrl>
    <Cem_ctrl>-1.468114306</Cem_ctrl>
    <Cen_ctrl>0.256819731</Cen_ctrl>
  </control_surface>
  <control_surface>
    <name>rudder_joint</name>
    <direction>1</direction>
    <index>3</index>
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    <CY_ctrl>-0.106106779</CY_ctrl>
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    <Cell_ctrl>-0.315686913</Cell_ctrl>
    <Cem_ctrl>0.066726944</Cem_ctrl>
    <Cen_ctrl>0.197952548</Cen_ctrl>
  </control_surface>
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  <windSubTopic>world_wind</windSubTopic>
</plugin>
<plugin name='puller' filename='libgazebo_motor_model.so'>
  <robotNamespace></robotNamespace>
  <jointName>rotor_puller_joint</jointName>
  <linkName>rotor_puller</linkName>
```

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  <turningDirection>cw</turningDirection>
  <timeConstantUp>0.0125</timeConstantUp>
  <timeConstantDown>0.025</timeConstantDown>
  <maxRotVelocity>1906</maxRotVelocity>
  <motorConstant>2.863e-05</motorConstant>
  <momentConstant>0.01</momentConstant>
  <commandSubTopic>/gazebo/command/motor_speed</commandSubTopic>
  <motorNumber>4</motorNumber>
  <rotorDragCoefficient>4.e-06</rotorDragCoefficient>
  <rollingMomentCoefficient>0</rollingMomentCoefficient>
  <motorSpeedPubTopic>/motor_speed/4</motorSpeedPubTopic>
  <rotorVelocitySlowdownSim>10</rotorVelocitySlowdownSim>
  <robotNamespace></robotNamespace>
  <windSubTopic>world_wind</windSubTopic>
 </plugin>
 <plugin name='groundtruth_plugin' filename='libgazebo_groundtruth_plugin.so'>
  <robotNamespace/>
 </plugin>
 <plugin name='magnetometer_plugin' filename='libgazebo_magnetometer_plugin.so'>
  <robotNamespace/>
  <pubRate>100</pubRate>
  <noiseDensity>0.0004</noiseDensity>
  <randomWalk>6.4e-06</randomWalk>
  <biasCorrelationTime>600</biasCorrelationTime>
  <magTopic>/mag</magTopic>
 </plugin>
 <plugin name='barometer_plugin' filename='libgazebo_barometer_plugin.so'>
  <robotNamespace/>
  <pubRate>50</pubRate>
  <baroTopic>/baro</baroTopic>
 </plugin>
 <plugin name='mavlink_interface' filename='libgazebo_mavlink_interface.so'>
  <robotNamespace></robotNamespace>
  <imuSubTopic>/imu</imuSubTopic>
  <magSubTopic>/mag</magSubTopic>
  <baroSubTopic>/baro</baroSubTopic>
  <mavlink_addr>INADDR_ANY</mavlink_addr>
  <mavlink_tcp_port>{{ mavlink_tcp_port }}</mavlink_tcp_port>
  <mavlink_udp_port>{{ mavlink_udp_port }}</mavlink_udp_port>
  <serialEnabled>{{ serial_enabled }}</serialEnabled>
  <serialDevice>{{ serial_device }}</serialDevice>
  <baudRate>{{ serial_baudrate }}</baudRate>
  <qgc_addr>INADDR_ANY</qgc_addr>
  <qgc_udp_port>14550</qgc_udp_port>
  <sdk_addr>INADDR_ANY</sdk_addr>
  <sdk_udp_port>14540</sdk_udp_port>
  <hil_mode>{{ hil_mode }}</hil_mode>
  <hil_state_level>false</hil_state_level>
  <enable_lockstep>true</enable_lockstep>
  <use_tcp>true</use_tcp>
```

<motorSpeedCommandPubTopic>/gazebo/command/motor_speed</motorSpeedCommandPubTopic>
    <control_channels>
      <channel name="rudder">
        <input_index>2</input_index>
        <input_offset>0</input_offset>
        <input_scaling>1</input_scaling>
        <zero_position_disarmed>0</zero_position_disarmed>
        <zero_position_armed>0</zero_position_armed>
        <joint_control_type>position_kinematic</joint_control_type>
        <joint_name>rudder_joint</joint_name>
      </channel>
      <channel name="throttle">
        <input_index>4</input_index>
        <input_offset>0</input_offset>
        <input_scaling>1906</input_scaling>
        <zero_position_disarmed>0</zero_position_disarmed>
        <zero_position_armed>0</zero_position_armed>
        <joint_control_type>velocity</joint_control_type>
        <joint_name>rotor_puller_joint</joint_name>
      </channel>
      <channel name="left_elevon">
        <input_index>5</input_index>
        <input_offset>0</input_offset>
        <input_scaling>1</input_scaling>
        <zero_position_disarmed>0</zero_position_disarmed>
        <zero_position_armed>0</zero_position_armed>
        <joint_control_type>position_kinematic</joint_control_type>
        <joint_name>left_elevon_joint</joint_name>
      </channel>
      <channel name="right_elevon">
        <input_index>6</input_index>
        <input_offset>0</input_offset>
        <input_scaling>1</input_scaling>
        <zero_position_disarmed>0</zero_position_disarmed>
        <zero_position_armed>0</zero_position_armed>
        <joint_control_type>position_kinematic</joint_control_type>
        <joint_name>right_elevon_joint</joint_name>
      </channel>
      <channel name="elevator">
        <input_index>7</input_index>
        <input_offset>0</input_offset>
        <input_scaling>1</input_scaling>
        <zero_position_disarmed>0</zero_position_disarmed>
        <zero_position_armed>0</zero_position_armed>
        <joint_control_type>position_kinematic</joint_control_type>
        <joint_name>elevator_joint</joint_name>
      </channel>
      <channel name="left_flap">
        <input_index>3</input_index>
        <input_offset>0</input_offset>

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          <zero_position_disarmed>0</zero_position_disarmed>
          <zero_position_armed>0</zero_position_armed>
          <joint_control_type>position_kinematic</joint_control_type>
          <joint_name>left_flap_joint</joint_name>
        </channel>
        <channel name="right_flap">
          <input_index>8</input_index>
          <input_offset>0</input_offset>
          <input_scaling>-1</input_scaling>
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          <joint_name>right_flap_joint</joint_name>
        </channel>
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      <imuTopic>/imu</imuTopic>
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  </model>
</sdf>
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