Appendix F: Example World File and Model File Used During Evaluation of 2004 GCE Course Segment 2570-2571-2572

```
<?xml version="1.0"?>

<gazebo:world
  xmlns:xi="http://www.w3.org/2001/XInclude"
  xmlns:gazebo="http://playerstage.sourceforge.net/gazebo/xmlschema/#gz
"
  xmlns:model="http://playerstage.sourceforge.net/gazebo/xmlschema/#mod
el"
  xmlns:sensor="http://playerstage.sourceforge.net/gazebo/xmlschema/#se
nsor"
  xmlns:window="http://playerstage.sourceforge.net/gazebo/xmlschema/#wi
ndow"
  xmlns:param="http://playerstage.sourceforge.net/gazebo/xmlschema/#par
am"
  xmlns:body="http://playerstage.sourceforge.net/gazebo/xmlschema/#body
"
  xmlns:geom="http://playerstage.sourceforge.net/gazebo/xmlschema/#geom
"
  xmlns:joint="http://playerstage.sourceforge.net/gazebo/xmlschema/#joi
nt"
  xmlns:interface="http://playerstage.sourceforge.net/gazebo/xmlschema/
#interface"
  xmlns:ui="http://playerstage.sourceforge.net/gazebo/xmlschema/#ui"
  xmlns:rendering="http://playerstage.sourceforge.net/gazebo/xmlschema/
#rendering"
  xmlns:controller="http://playerstage.sourceforge.net/gazebo/xmlschema
/#controller"
  xmlns:physics="http://playerstage.sourceforge.net/gazebo/xmlschema/#p
hysics" >

  <verbosity>5</verbosity>

  <physics:ode>
    <stepTime>0.001</stepTime>
    <gravity>0 0 -9.80665</gravity>
    <cfm>10e-5</cfm>
    <erp>0.8</erp>
    <!-- updateRate: <0 == throttle simTime to match realTime.
                      0 == No throttling
                     >0 == Frequency at which to throttle the sim -->
    <updateRate>0</updateRate>
  </physics:ode>

  <rendering:gui>
    <type>fltk</type>
    <size>640 480</size>
    <pos>0 0</pos>
  </rendering:gui>

  <rendering:ogre>
    <ambient>0.4 0.4 0.4 1.0</ambient>
    <sky>
      <material>Gazebo/CloudySky</material>
    </sky>
```

```
    </rendering:ogre>

   <!-- Ground Plane -->
  <model:physical name="plane1_model">
    <xyz>0 0 0</xyz>
    <rpy>0 0 0</rpy>
    <static>true</static>
    <body:plane name="plane1_body">
      <geom:plane name="plane1_geom">
        <normal>0 0 1</normal>
        <size>2000 2000</size>
        <segments>10 10</segments>
        <uvTile>100 100</uvTile>
        <material>Gazebo/GrassFloor</material>
        <visual>
          <rpy>0 0 0</rpy>
          <mesh>models/02.7.924.mesh</mesh>
          <scale>1 1 1</scale>
          <material>Gazebo/Grey</material>
        </visual>
      </geom:plane>
    </body:plane>
  </model:physical>

  <!-- The camera -->
  <model:physical name="cam1_model">
    <xyz>0 0 20</xyz>
    <rpy>0 0 180</rpy>
    <static>true</static>
    <body:empty name="cam1_body">
      <sensor:camera name="cam1_sensor">
        <nearClip>0.1</nearClip>
        <farClip>100</farClip>
<!-- not in use, but named parameter
        <saveFrames>false</saveFrames>
        <saveFramePath>frames</saveFramePath>
-->
        <imageSize>640 480</imageSize>
<!-- not in use, but named parameter
        <mask></mask>
-->
        <hfov>60</hfov>
<!-- allowed image formats are: L8, R8G8B8, B8G8R8 ref: OgreCamera.cc
-->
        <imageFormat>R8G8B8</imageFormat>
<!-- not in use, but named parameter
        <updateRate></updateRate>
-->
        <controller:generic_camera name="camera_controller">
          <interface:camera name="camera_iface_0"/>
        </controller:generic_camera>
      </sensor:camera>
    </body:empty>
  </model:physical>
```

```
  <model:physical name="cv_model">
    <xyz>0.0 3.072 0.1</xyz>
    <rpy>0.0 0.0 0.0</rpy>
    <static>false</static>
<!--
The include should be last within a model. All previous statements
will override those in the included file
-->
    <include embedded="true">
      <xi:include href="models/cv.model" />
    </include>
  </model:physical>

  <!-- White Directional light -->
  <model:renderable name="directional_white">
    <static>true</static>
    <light>
      <type>directional</type>
      <direction>0 -0.8 -0.3</direction>
      <diffuseColor>0.9 0.9 0.9</diffuseColor>
      <specularColor>0.0 0.0 0.0</specularColor>
      <range>100</range>
      <!-- Constant(0-1) Linear(0-1) Quadratic -->
      <attenuation>0.0 1.0 0.4</attenuation>
    </light>
  </model:renderable>

</gazebo:world>
```

```
<?xml version="1.0"?>

<!-- Challenge Vehicle Model -->
<model:physical name="cv_model"
  xmlns:model="http://playerstage.sourceforge.net/gazebo/xmlschema/#mod
el"
  xmlns:sensor="http://playerstage.sourceforge.net/gazebo/xmlschema/#se
nsor"
  xmlns:body="http://playerstage.sourceforge.net/gazebo/xmlschema/#body
"
  xmlns:geom="http://playerstage.sourceforge.net/gazebo/xmlschema/#geom
"
  xmlns:joint="http://playerstage.sourceforge.net/gazebo/xmlschema/#joi
nt"
  xmlns:controller="http://playerstage.sourceforge.net/gazebo/xmlschema
/#controller"
  xmlns:interface="http://playerstage.sourceforge.net/gazebo/xmlschema/
#interface"
  xmlns:visual="http://playerstage.sourceforge.net/gazebo/xmlschema/#vi
sual"
>

<!--
  The following conventions are used herein:
   SI units were used to model the challenge vehicle and create the
mesh.
   "Length" refers to dimensions along the x-axis.
   "Width" refers to dimensions along the y-axis.
   "Height" refers to dimensions along the z-axis.

  The overall dimensions of the Team 2005-06 challenge vehicle were:
    Length:                    174.9 in (4.442 m)
    Width:                      70.1 in (1.780 m)
    Height:                     70.4 in (1.788 m)
    Track width (front):        61.1 in (1.552 m)
    Track width (rear):         60.2 in (1.529 m)
    Bumper to front axle:       34.1 in (0.866 m)
    Wheelbase:                 103.1 in (2.619 m)
    Rear axle to end of frame:  37.7 in (0.958 m)
    Ground clearance:           10.0 in (0.254 m)
      The chassis_body visual is located 0.495 m from the ground, to
compensate for ground clearance and an error
        of 0.894 - 0.653 = 0.241 m in distance from the ground
    Curb weight:              3792.0 lb (1720.0 kg)

  The stock tires on the Team 2005-06 challenge vehicle were
"P235/70TR16.0 BSW AS" tires.  Team 2005-06
   replaced the stock tires on their challenge vehicle with: "off-road
tires that provide an extra inch of
   clearance.  The new tires also have reinforced sidewalls and thicker
tread to help prevent flat tires
   due to the rocky terrain."  However, Team 2005-06 provided no
additional identifying information for
   the tires in use by the team.  The author used the dimensions of the
```

Team 2005-06 challenge vehicle
stock tires herein, and did not alter the ground clearance of the challenge vehicle.

The overall dimensions of the Team 2005-06 challenge vehicle tires were:

Section width:	9.3 in (0.235 m)
Sidewall height (from rim to tread):	6.5 in (0.165 m)
Rim diameter:	16.0 in (0.406 m)
Tire radius:	14.5 in (0.368 m)

Sidewall height (from rim to tread) is equal to 70 percent of the section width. The sidewall aspect ratio for the Team 2005-06 challenge vehicle tires was 70.

Tire radius is equal to one-half the rim diameter plus the sidewall height (from rim to tread).

Miscellaneous dimensions calculated to model the Team 2005-06 challenge vehicle:

Chassis body width:	47.9 in (1.218 m)
Chassis body height:	12.0 in (0.305 m)
anchorOffset (rear):	1.5 in (0.038 m)
anchorOffset (front):	2.0 in (0.050 m)
Height of the center of gravity:	25.7 in (0.653 m)
Front axle to center of gravity x-dimension:	53.4 in (1.356 m)
Center of gravity to rear axle x-dimension:	49.8 in (1.265 m)
Front and rear axle to center of gravity z-dimension:	20.7 in (0.526 m)
Wheel well radius:	20.0 in (0.508 m)
xy-origin to base of hood z-dimension (three-sevenths overall height):	(0.766 m)
xy-origin to base of windshield z-dimension (four-sevenths overall height):	(1.022 m)
xy-origin to front and rear axle z-dimension:	6.0 in (0.152 m)
yz-origin to base of windshield x-dimension:	54.1 in (1.374 m)
yz-origin to base of roof x-dimension:	74.1 in (1.882 m)
yz-origin to rear axle x-dimension:	140.8 in (3.576 m)
Roof length:	100.8 in (2.560 m)
Front axle to end of frame x-dimension:	140.8 in (3.576 m)

The width of the chassis body is equal to the track width (rear) minus section width minus twice the anchorOffset (rear). An arbitrary anchorOffset (rear) of 1.5 inches (0.0381 m) was selected.

```
  The anchorOffset (front) is equal to one-half the track width (front)
minus one-half the width of the chassis
   body, minus one-half the tire width.
  The z-dimension of the anchorOffset is equal to the height of the
center of gravity minus tire radius.
  The center of gravity of the model is located at the center of mass
of the chassis body.  Tires have been no mass
   as a result.
  The height of the center of gravity is equal to track width (rear)
divided by twice the vehicle's static stability
   factor.
  Roof length is equal to chassis length minus the yz-origin to base of
roof x-dimension.
  The xy-origin to front and rear axle z-dimension is equal to tire
radius minus ground clearance.
  Front axle to end of frame x-dimension is equal to wheelbase plus
rear axle to end of frame.
  Bumper to axle is equal to the chassis length minus wheelbase minus
rear axle to end of frame, or
   chassis length minus front axle to end of frame x-dimension.
-->

  <xyz>0 0 0</xyz>
  <rpy>0 0 0</rpy>
  <canonicalBody>chassis_body</canonicalBody>
  <controller:steering_position2d name="steering_controller">
    <updateRate>50</updateRate>
    <wheel>
      <jointName>left_front_wheel_hinge</jointName>
      <type>full</type>
      <torque>10000</torque>
      <steerTorque>10000</steerTorque>
    </wheel>
    <wheel>
      <jointName>right_front_wheel_hinge</jointName>
      <type>full</type>
      <torque>10000</torque>
      <steerTorque>10000</steerTorque>
    </wheel>
    <wheel>
      <jointName>left_rear_wheel_hinge</jointName>
      <type>drive</type>
      <torque>10000</torque>
    </wheel>
    <wheel>
      <jointName>right_rear_wheel_hinge</jointName>
      <type>drive</type>
      <torque>10000</torque>
    </wheel>
    <useSwaybars>false</useSwaybars>
    <swayForce>300</swayForce>
    <swayForceLimit>15</swayForceLimit>
    <useConstantVelocityMode>true</useConstantVelocityMode>
    <useConstantSteeringAngleMode>false</useConstantSteeringAngleMode>
```

```
  <constantSteeringAngle>0.314852</constantSteeringAngle>
  <useSafeVelocity>true</useSafeVelocity>
  <velocityOffset>2.5</velocityOffset>
  <useTurnRadius>true</useTurnRadius>
  <turnRadius>46.1</turnRadius>
  <turningCircle>11.491</turningCircle>
  <trackWidth>1.529</trackWidth>
  <wheelBase>2.619</wheelBase>
  <ssf>1.17</ssf>
  <velocityFinal>26.822</velocityFinal>
  <velocityFinalTime>5.0</velocityFinalTime>
  <tireRadius>0.368</tireRadius>
  <sectionWidth>0.235</sectionWidth>
  <interface:position name="position_iface_0"/>
</controller:steering_position2d>
<body:box name="chassis_body">
  <geom:box name="chassis_geom">
    <xyz>0 0 0.653</xyz>
    <size>4.442 1.218 0.305</size>
    <mass>1720</mass>
    <visual>
      <mesh>unit_box</mesh>
      <scale>4.242 1.218 0.305</scale>
      <material>Gazebo/Green</material>
    </visual>
    <visual>
      <xyz>0 0 0.495</xyz>
      <rpy>0 0 0</rpy>
      <mesh>../../Media/models/cv.mesh</mesh>
      <material>Gazebo/Pioneer2Body</material>
      <scale>1 1 1</scale>
    </visual>
  </geom:box>
</body:box>
<body:cylinder name="left_front_wheel">
  <xyz>1.355 0.776 0.368</xyz>
  <rpy>90 0 0</rpy>
  <geom:cylinder name="left_front_wheel_geom">
    <size>0.368 0.235</size>
    <visual>
      <mesh>../../Media/models/Pioneer2at/tire.mesh</mesh>
      <rpy>-90 0 0</rpy>
      <size>0.736 0.235 0.736</size>
      <material>Gazebo/Black</material>
    </visual>
    <visual>
      <mesh>../../Media/models/Pioneer2at/wheel.mesh</mesh>
      <rpy>-90 0 0</rpy>
      <size>0.736 0.235 0.736</size>
      <material>Gazebo/Gold</material>
    </visual>
  </geom:cylinder>
</body:cylinder>
<body:cylinder name="right_front_wheel">
```

```
  <xyz>1.355 -0.776 0.368</xyz>
  <rpy>-90 0 0</rpy>
  <geom:cylinder name="right_front_wheel_geom">
    <size>0.368 0.235</size>
    <visual>
      <mesh>../../Media/models/Pioneer2at/tire.mesh</mesh>
      <rpy>-90 0 0</rpy>
      <size>0.736 0.235 0.736</size>
      <material>Gazebo/Black</material>
    </visual>
    <visual>
      <mesh>../../Media/models/Pioneer2at/wheel.mesh</mesh>
      <rpy>-90 0 0</rpy>
      <size>0.736 0.235 0.736</size>
      <material>Gazebo/Gold</material>
    </visual>
  </geom:cylinder>
</body:cylinder>
<body:cylinder name="left_rear_wheel">
  <xyz>-1.264 0.765 0.368</xyz>
  <rpy>90 0 0</rpy>
  <finiteRotationMode>0</finiteRotationMode>
  <finiteRotationAxis>0 1 0</finiteRotationAxis>
  <geom:cylinder name="left_rear_wheel_geom">
    <size>0.368 0.235</size>
    <visual>
      <mesh>../../Media/models/Pioneer2at/tire.mesh</mesh>
      <rpy>-90 0 0</rpy>
      <size>0.736 0.235 0.736</size>
      <material>Gazebo/Black</material>
    </visual>
    <visual>
      <mesh>../../Media/models/Pioneer2at/wheel.mesh</mesh>
      <rpy>-90 0 0</rpy>
      <size>0.736 0.235 0.736</size>
      <material>Gazebo/Gold</material>
    </visual>
  </geom:cylinder>
</body:cylinder>
<body:cylinder name="right_rear_wheel">
  <xyz>-1.264 -0.765 0.368</xyz>
  <rpy>-90 0 0</rpy>
  <finiteRotationMode>0</finiteRotationMode>
  <finiteRotationAxis>0 1 0</finiteRotationAxis>
  <geom:cylinder name="right_rear_wheel_geom">
    <size>0.368 0.235</size>
    <visual>
      <mesh>../../Media/models/Pioneer2at/tire.mesh</mesh>
      <rpy>-90 0 0</rpy>
      <size>0.736 0.235 0.736</size>
      <material>Gazebo/Black</material>
    </visual>
    <visual>
      <mesh>../../Media/models/Pioneer2at/wheel.mesh</mesh>
```

```
        <rpy>-90 0 0</rpy>
        <size>0.736 0.235 0.736</size>
        <material>Gazebo/Gold</material>
      </visual>
    </geom:cylinder>
  </body:cylinder>
  <joint:hinge2 name="left_front_wheel_hinge">
    <body1>chassis_body</body1>
    <body2>left_front_wheel</body2>
    <anchor>left_front_wheel</anchor>
    <axis1>0 0 1</axis1>
    <axis2>0 1 0</axis2>
    <erp>0.8</erp>
    <cfm>10e-5</cfm>
  </joint:hinge2>
  <joint:hinge2 name="right_front_wheel_hinge">
    <body1>chassis_body</body1>
    <body2>right_front_wheel</body2>
    <anchor>right_front_wheel</anchor>
    <axis1>0 0 1</axis1>
    <axis2>0 1 0</axis2>
    <erp>0.8</erp>
    <cfm>10e-5</cfm>
  </joint:hinge2>
  <joint:hinge name="left_rear_wheel_hinge">
    <body1>chassis_body</body1>
    <body2>left_rear_wheel</body2>
    <anchor>left_rear_wheel</anchor>
    <axis>0 1 0</axis>
    <erp>0.8</erp>
    <cfm>10e-5</cfm>
  </joint:hinge>
  <joint:hinge name="right_rear_wheel_hinge">
    <body1>chassis_body</body1>
    <body2>right_rear_wheel</body2>
    <anchor>right_rear_wheel</anchor>
    <axis>0 1 0</axis>
    <erp>0.8</erp>
    <cfm>10e-5</cfm>
  </joint:hinge>
</model:physical>
```