

OA1

2008

# Obstacle Avoidance with ROS and gazebo

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WEEK 7

## ~~URDF~~ URDF

• Unified Robot Description Format

• Phy. specs → XML representation → Sim Env.

Outline: (URDF and you; YT)

• XML spec

• Tools

• Limits

## 1 Links & Joints

• URDF is xml and is made up of

2 links and joints.

• P.T.R:-

• every link only has 1 parent link.

It can have multiple childs.

• order of code doesn't matter.

• Tree structure is created

5 • Basic Syntax:-

<?xml version="1.0"?>

<robot name="sample"> Sunday 17

<link name=" " />

tab

<joint name=" " type=" " />

<parent link=" " />

<child link=" " />

</joint>

</robot>

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# Geometry

## Coordinate frames (TF)

Parent Frame Child frame

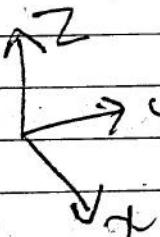
Translation:-

xyz (meters)

Rotation:-

(Quaternion) in TF

Roll Pitch Yaw (rad) in URDF



x

Color

R

Roll

y

G

Pitch

z

B

Yaw

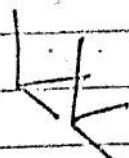
## Geometry of Joints

Using the <origin /> tag inside of the joint tag



<origin xyz="0 0 0"

rpy="0 0 0"/>



<origin xyz="0.5 0 0"/>

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WEEK 9

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9  $\leftarrow \leftarrow \text{Corigin xyz} = "0.5 \ 0.4 \ 0"/>$

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11  $\leftarrow \downarrow \text{Corigin xyz} = "-5 \ 4 \ 0"$   
 $\text{rpy} = "0 \ 0 \ 1.5"/>$

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the ref. frame is the parent link  
 new frame is the child link

1 getting from the xmls to the  
 2 actual transform.

3 Publishing TF: ROBOT\_DESCRIPTION PARAM

4 urdf  $\xrightarrow{\text{load}}$  parameter server

5 core service

Put line in launch file:

6  $\text{<param name = "robot\_description"$   
 $\text{textfile = "\$(find roscm\_urdf)/urdf/sample.urdf"}$   
 $\text{/>}$

parameter named robot\\_description to  
 the content of the text file.

in this file all urdfs are in  
 a package roscm\\_urdf.

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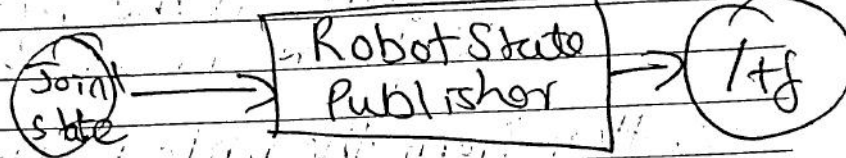
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WEEK 0

Running the Robot State Publisher (rsp)

Parameter Server  
/robot\_desc.p



rsp is a node.

```

<node name="robot-state-publisher"
  pkg="roscpp"
  type="state_publisher" />
  
```

- It requires joint state msgs as inputs & outputs the transform.
- joint state msgs come from the hardware. or for virtual viz. we can make a joint-state-pub node

```

<node name="joint-state-publisher"
  pkg="joint_state_publisher"
  type="joint_state_publisher" />
  
```

which outputs default 6 sm's.

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WEEK 9

# Types of Flexible Joints

• /fixed (no movement)

• /continuous (rotate about an axis)

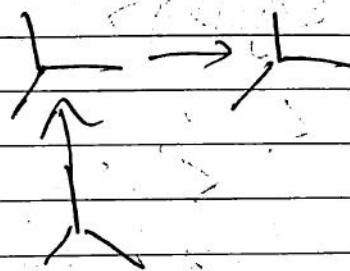
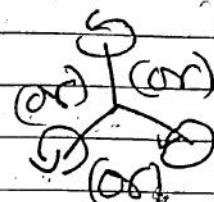
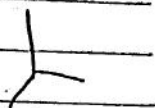
• /revolute (like continuous but have a region of rot.)

• /prismatic (translation no rot)

• Planar (2D) like a mouse

• /floating (6D)

# for a fixed joint, the joint state mgs will be empty strings.



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WEEK 9

Joint codes:  
 <joint name="" type="continuous">

10 <axis xyz="0 0 1"/>  
 </joint>

11 <joint name="" type="revolute">

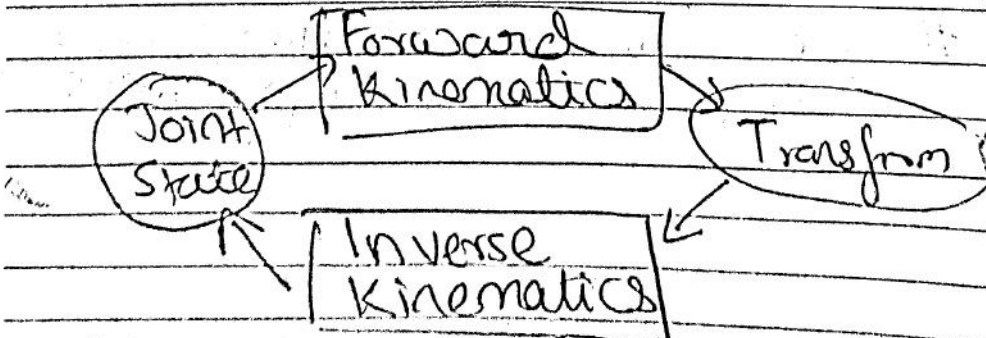
12 0 <limit upper="3.14" lower="-3.14"  
 velocity="1.0" effort="1.0"/>

1 <axis xyz="0 0 1"/>  
 2 </joint>

3 <...>  
 4 "a"="0.54" "r"="0.82"  
 "a"="1.0" "r"="1.0"/>

5 <axis xyz="0 -1 0"/>  
 </joint>

6 Kinematics with KDL



KDL: Kinematics & Dynamics Lib.  
[ros.org/wiki/arm-navigation](http://ros.org/wiki/arm-navigation)

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WEEK 10

Visualization: Geometry and Material  
we can add info to links.

10 <link name="sphere">  
<visual>

11 <geometry>  
<sphere radius=".5"/>

12 </geometry>  
<material name="red">  
1 <color rgba="1 0 0 1"/>  
</material>

2 </visual>  
</link>

3 Similarly for cylinder (rad length) box (size)

4 mesh (inside geo)

5 <mesh filename="" />

6 On add texture (inside material)  
<texture filename="" /> Sunday 9

On make mesh in blender, sketchup,  
↳ .dae file.

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WEEK 11

Visual Origin

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we have already seen the joint origin, why need a link origin?

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## Geometry: Collisions

Option of using a diff. Usually simpler geometry for collision workings

Link

<visual>

<geometry>

<mesh name = " " />

</geometry>

<visual>

<collision>

<geometry>

<mesh name = " " />

</geometry>

</collision>

</link>

[ros.org/wiki/collision\\_environment](http://ros.org/wiki/collision_environment)

## Simulation: Inertia & Joint properties

We want to add some physical props to our model for simulations. Like inertia to links, mass, safety limits

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eg.

&lt;link name="shoulder\_pan\_link"&gt;

&lt;inertial&gt;

&lt;mass="25.749322"/&gt;

&lt;origin xyz="-0.001 0.24 -0.097"/&gt;

&lt;inertia ixx="0.966" iyy="0.061" izz="0.061" ixy="0" iyz="0" izx="0"/&gt;

&lt;/inertial&gt;

&lt;/link&gt;

&lt;joint name="shoulder\_pan\_jt"&gt;

type="revolute"&gt;

&lt;limit lower="-2.28" upper="0.001" effort="30" velocity="2.08"/&gt;

&lt;safety\_controller

k\_position="100"

k\_velocity="10"

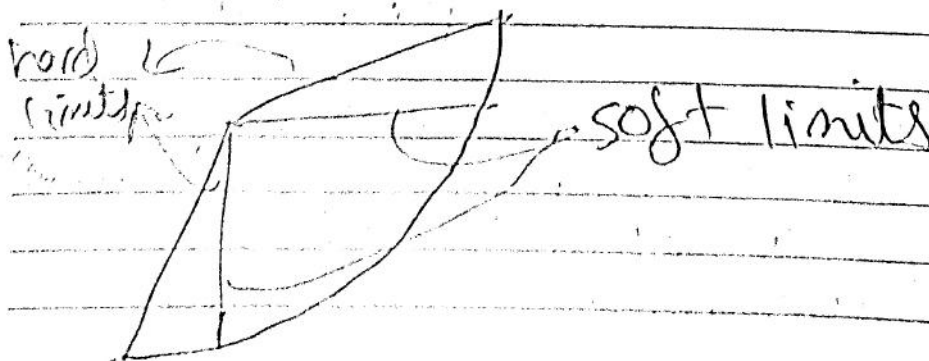
soft\_lower\_limit="-2.14"

soft\_upper\_limit="0.56"

&lt;dynamics damping="10.0"/&gt;

&lt;calibration rising="-0.785"/&gt;

&lt;/joint&gt;



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WEEK 12

gazebo exclusive tags (pr 2 specific)

eg transmission, gazebo, using  
motor gravityeg. <transmission name="shoy-pen-brens"  
type="pr2-mechanism-model/  
SimpleTransmission"><joint name=""/>  
<actuator name="n-motor"/>

&lt;mechanicalReduction&gt;

63.1552452977

&lt;/mechanicalReduction&gt;

&lt;/transmission&gt;

eg. <gazebo reference="r-gripper-r-finger-  
link"/>

&lt;turnGravityOff&gt;true&lt;/turnGr. off&gt;

&lt;mu1 value="500.0"/&gt;

&lt;mu2 value="9500.0"/&gt;

&lt;kp value="1000000.0"/&gt;

&lt;kd value="110"/&gt;

&lt;/gazebo&gt;

ros.org/wiki/gazebo

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WEEK 12

Tools: APIs and basic  
Utilities

10 C++

Python

• urdf-parser

• urdf-python

urdf-interface

12

• joint-state-pub.

• robot-state-publisher

• check urdf

• urdf to graphviz

2

Gviz

3

• checks without sim.

4 Conversion tools.

5

eg collada, IVCN,

simmechanics-to-urdf.

6

Most imp tool: Xacro

Launching with xacro

```
<param name="robot_description"
```

```
command=" $(find xacro)/xacro.py
```

```
$(find roscm_urdf)/urdf/
```

```
ll-xacro.xacro"
```

/&gt;

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WEEK 12

Xacro Properties

Kinda like variables.

eg.

```
<xacro:propert name="width"
value="0.2"/>
```

```
<cylinder radius="$width/2"/>
```

Xacrofullmacro ★making smaller, easily maintainable  
or dff files :-

eg

```
<xacro:macro name="leg"
params="prefix reflect">
<link name="$prefix3.leg">
```

code

```
<origin xyz="$reflect*width 0.25"/>
```

&lt;/xacro:macro&gt;

```
<xacro:leg prefix="right" reflect="1">
< " " "left" " " "1">
```

we were able to write code once  
& pass params

Kinda like using functions.

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