Session 2: Let's build a Robot and SLAM(no pun) it
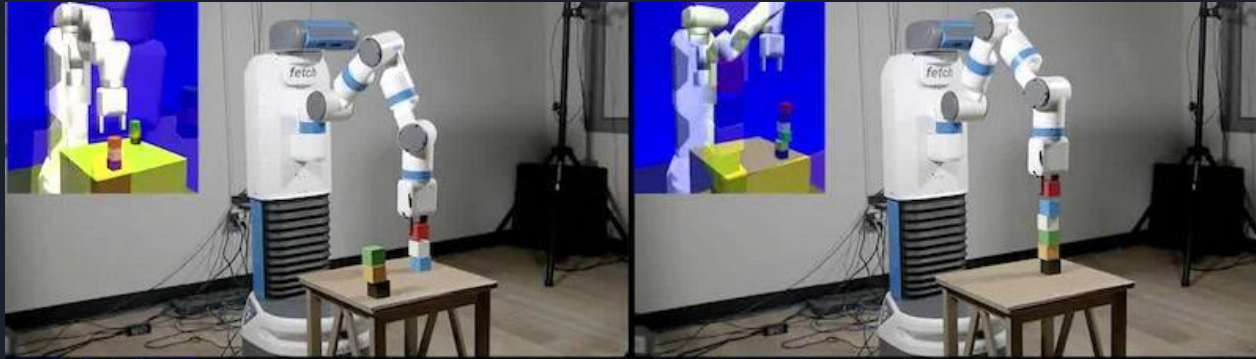
➤ Introduction to URDF

➤ Build a robot model in URDF format

➤ Keyboard control of the robot

➤ SLAM on a robot

What is **URDF**?

- URDF stands for Unified Robot Description Format
- For using a 3D model of a Robot that you are working and simulating with in ROS,it has to be in URDF format only
- ROS has libraries/packages installed that parses the URDF files

Two approaches

➢ Writing your own URDF files from scratch and create a robot model
  - Boring,Time consuming
  - Highly prone to errors which are difficult to identify

➢ You can model your robot in CAD/3D modelling softwares like SolidWorks,Fusion 360,AutoCAD and use external packages /libraries to parse those 3D files

But in our session we are going to proceed with creating a model from scratch ourselves..... :)

Understanding the XML syntax
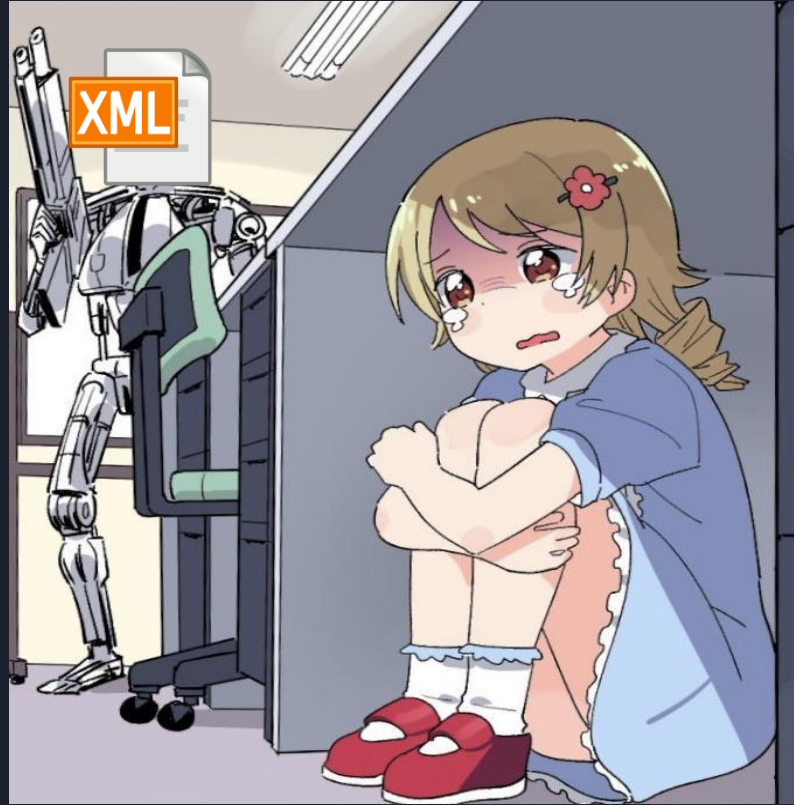
<robot>= Root element in desc file(similar to <html> tag)

<gazebo>= Element used to describe simulation properties

<sensor> = Used for inclusion of sensors like cameras,laser,etc
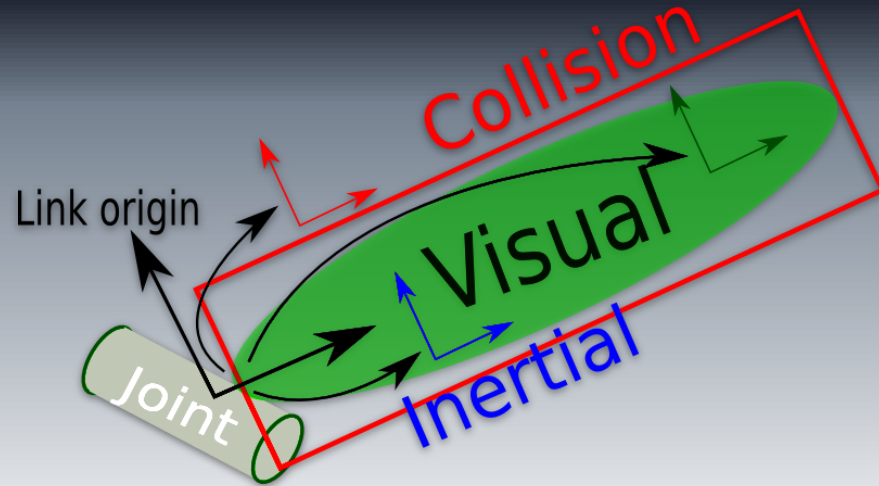
<material> = To describe the material properties like color,texture,etc

And many more.......

<geometry> ,**<inertial>** ,**<collision>** ,**<cylinder>** ,**<box>**
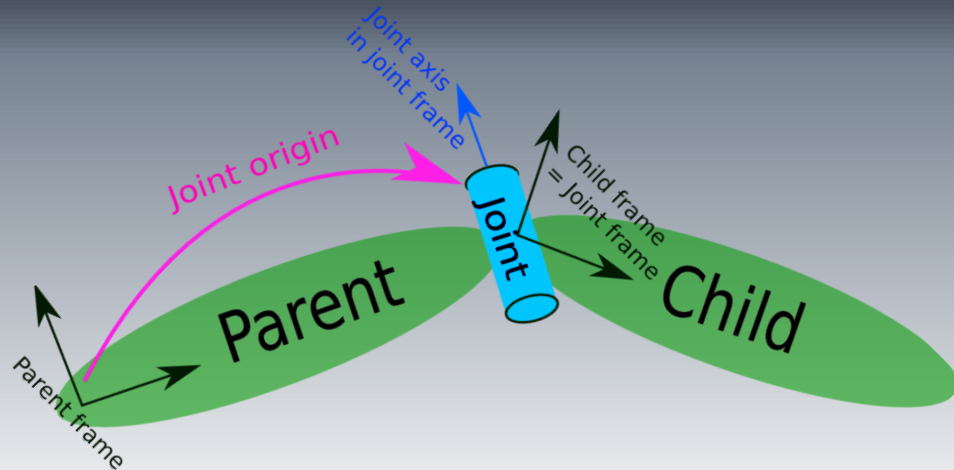
<link>

- This element describes a rigid body with inertia, visual features and collision properties

<joint>

- This element describes a kinematics and dynamics of a joint and also specifies the safety limits of it

Time to proceed with coding...

Simultaneous Localisation and Mapping(SLAM)

- Consider a home robot vacuum
- Without SLAM:
  - Moves randomly and will not be able to cover entire home
  - Excessive power usage
  - Too much time
- With SLAM
  - Use infos such as no of wheel revolutions ,datas from sensor to determine the amount of movement
  - Process also called as Localisation
  - Using the sensors robot can create a map of obstacle in its surroundings and avoid the clean area twice
  - Process also called as mapping
- Both the mapping and localisation takes place simultaneously and thus the name

Two types of SLAM:Visual and LiDAR

Visual slam:

- Makes use of image acquired from cameras and image sensors
- Different types of camera can be used such as Monocular,Stereo,Depth cameras
- Algorithms can be classified into two categories
  - Sparse Method: Matches feature points of images
  - Dense Method: Overall Brightness of Images
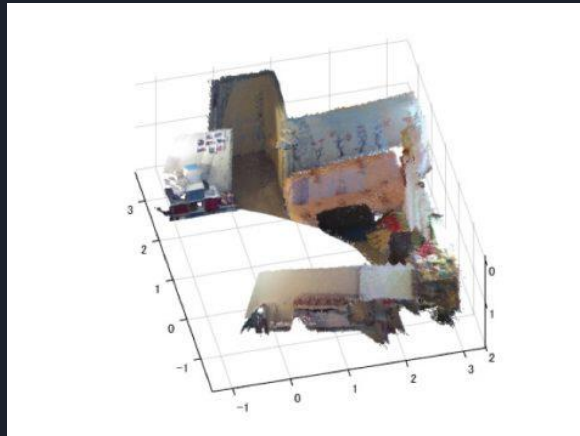
Two types of SLAM:Visual and LiDAR

LiDAR slam:

- Abbreviates to Light detection and ranging,primarily uses a laser sensor
- Output values from laser sensors are generally 2D or 3D point cloud data
- Laser sensor point cloud provides high precision distance measurements and works effectively for map construction with SLAM
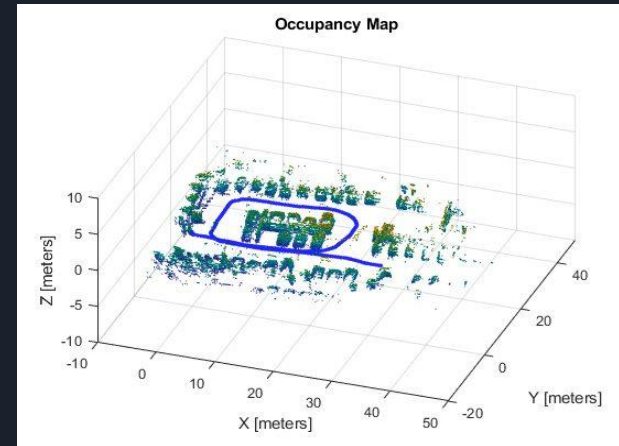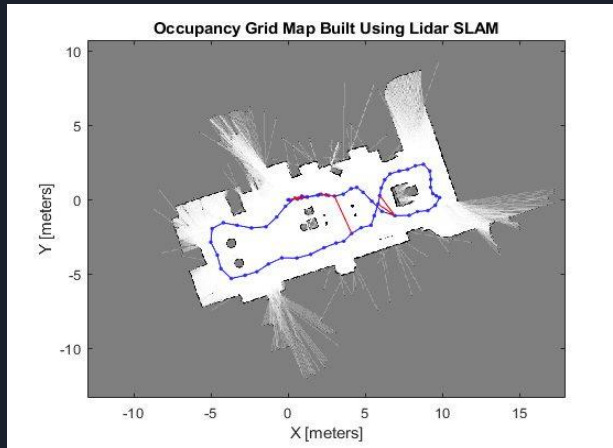
Lets see SLAM in action on a quadruped robot