# 1. MoveIt configuration



## 1.1. Start the program

```
#Raspberry Pi 5 master needs to enter docker first, please perform this step
#If running the script into docker fails, please refer to ROS/07, Docker tutorial
~/run_docker.sh
```

Start roscore

```
roscore
```

**<PI5 needs to open another terminal to enter the same docker container**

1. In the above steps, a docker container has been opened. You can open another terminal on the host (car) to view:

```
docker ps -a
```

```
jetson@ubuntu:~$ docker ps -a
CONTAINER ID   IMAGE                               COMMAND       CREATED      STATUS       PORTS     NAMES
5b698ea10535   yahboomtechnology/ros-foxy:3.3.9    "/bin/bash"   3 days ago   Up 9 hours             ecstatic_lewin
jetson@ubuntu:~$
```

2. Now enter the docker container in the newly opened terminal:

```
docker exec -it 5b698ea10535 /bin/bash
```

```
jetson@ubuntu:~$ docker ps -a
CONTAINER ID   IMAGE                               COMMAND       CREATED      STATUS       PORTS     NAMES
5b698ea10535   yahboomtechnology/ros-foxy:3.3.9    "/bin/bash"   3 days ago   Up 9 hours             ecstatic_lewin
jetson@ubuntu:~$ docker exec -it 5b698ea10535 /bin/bash
-------------------------------------------------------
my_robot_type: x3 | my_lidar: a1 | my_camera: astrapro
-------------------------------------------------------
root@ubuntu:/#
```

After successfully entering the container, you can open countless terminals to enter the container.

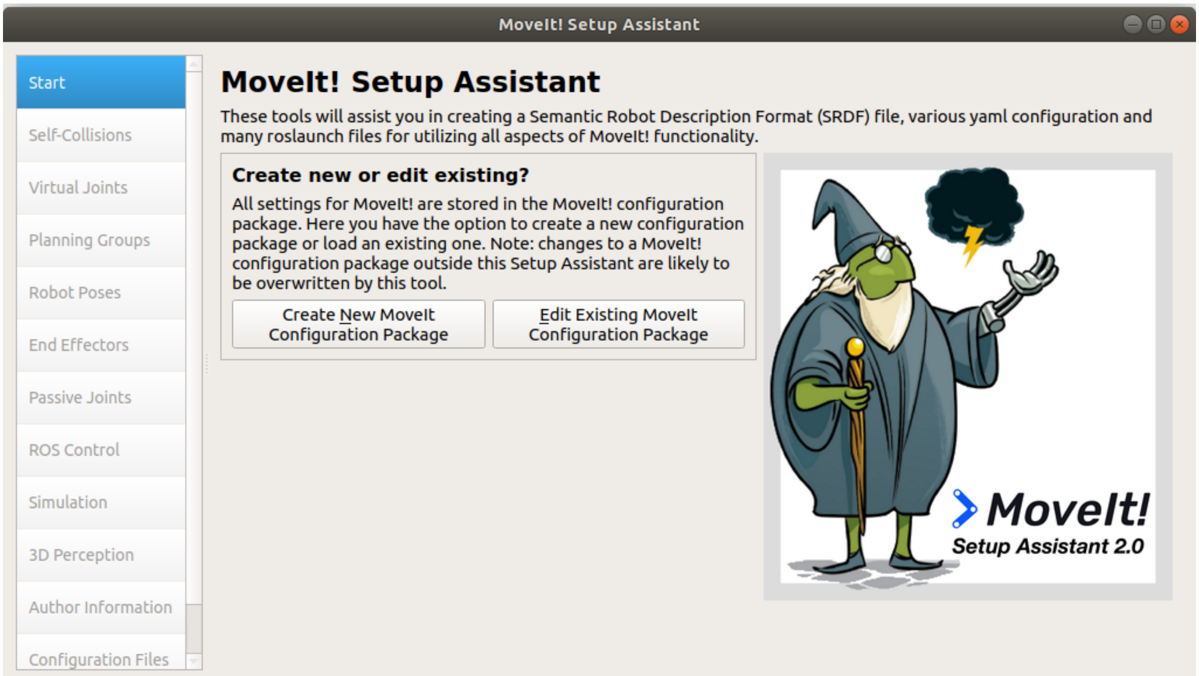
Start MoveIT

```
rosrun moveit_setup_assistant moveit_setup_assistant
```

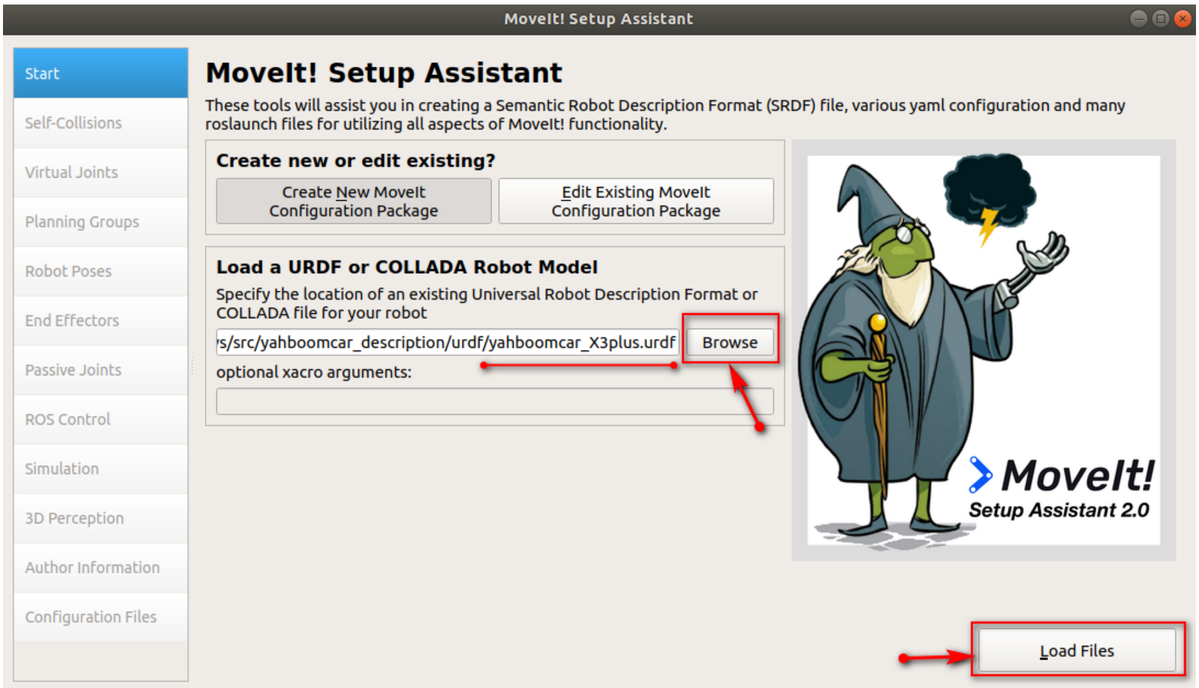
# 1.2. Configuration process

## 1.2.1. Load URDF model

If an error [model not found] is reported when loading the model, exit MoveIt-->enter the workspace-->compile (sudo apt update)-->update the environment (source devel/setup.bash)-->start the MoveIt configuration again . The interface after startup is as follows:




If you are loading the model generation configuration for the first time, click [Create New MoveIt Configuration Package]; if you are modifying the generated configuration file, click [Edit Existing MoveIt Configuration Package].

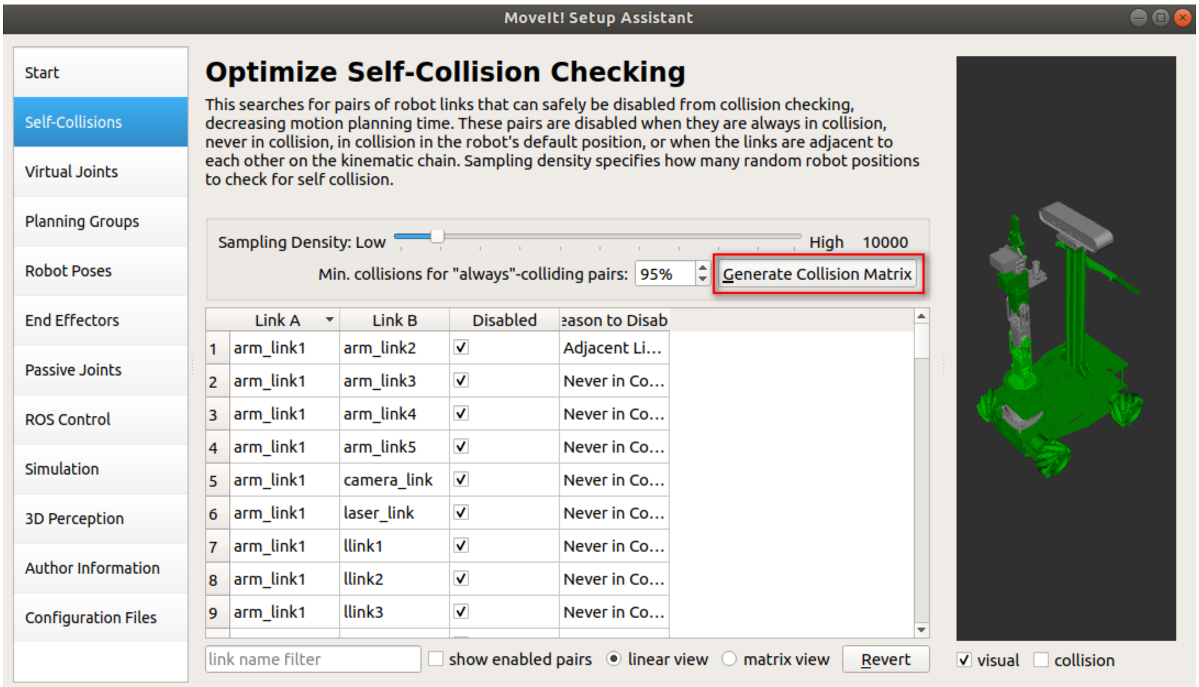



Click the [Browse] button, find the URDF model file, and click [Load Files] in the lower right corner to load it.

## 1.2.2. Create a collision-free matrix

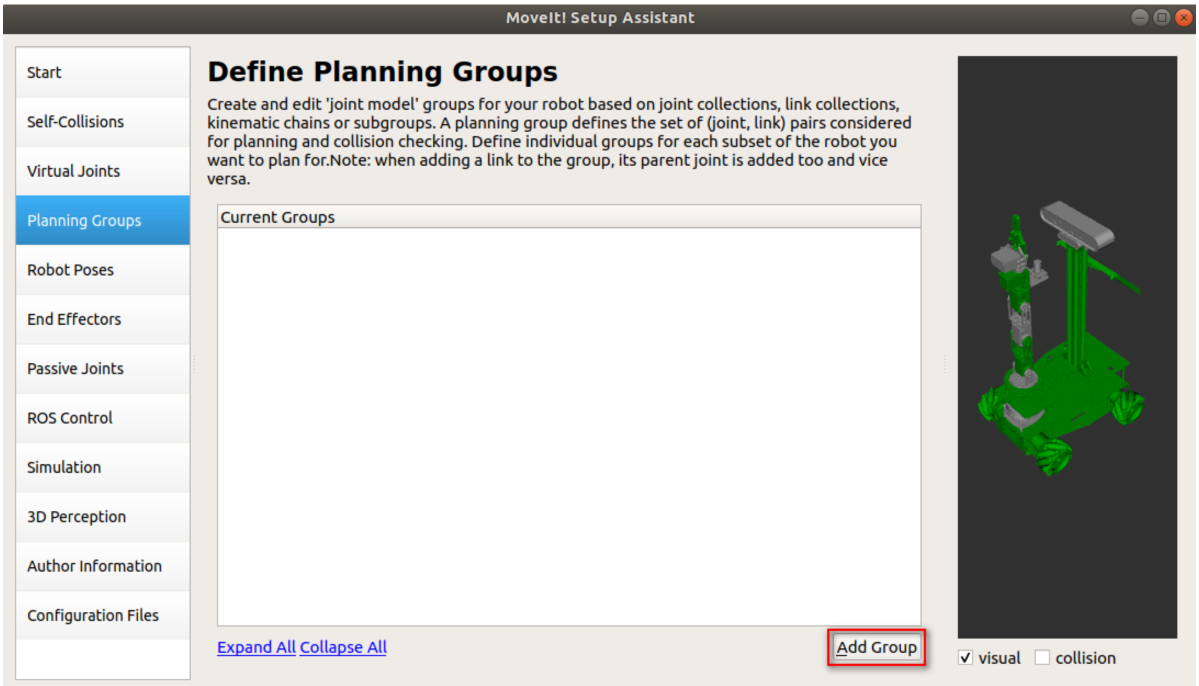
Collision detection is a very complex computational process. For multi-joint robotic arms or humanoid robots, the mechanical structure is complex and there are many joints, and collision detection requires a lot of spatial geometry calculations. But for rigid-body robots, collisions between some joints are impossible, such as adjacent limbs. The purpose of generating self-collision here is to tell us which joints will not collide with each other. In the subsequent collision detection algorithm, the detection between these joints can be directly skipped to improve detection efficiency.

After the model is loaded, select [Self-Collisions] and click the [Generate Collision Matrix] button.



## 1.2.3. Create a motion planning group

Planning Group is one of the core parts of MoveIt. Click [Add Group] to add a planning group




### 1.2.3.1. Add robotic arm planning group

If there is no [trac-ik] in the system, execute the following command to install it.

```
sudo apt-get install ros-melodic-trac-ik*
```

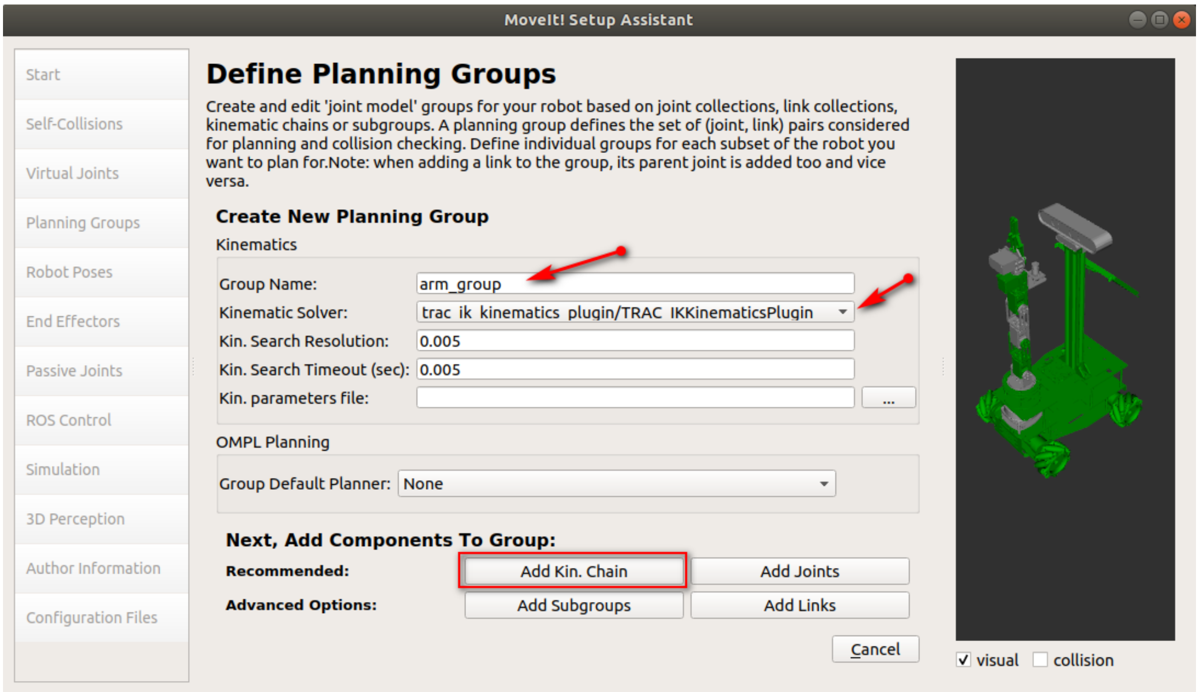
- Group Name: Create a group name and set it to [arm_group].
- Kinematic Solver: Here we choose [trac_ik]

  Kinematics solving tool, this is responsible for solving forward kinematics (Forward Kinematics) and inverse kinematics (IK). Generally we choose KDL, The Kinematics and Dynamics Library. This is a kinematics and dynamics library that can well solve the forward and inverse kinematics problems of single-chain mechanical structures with more than 6 degrees of freedom.

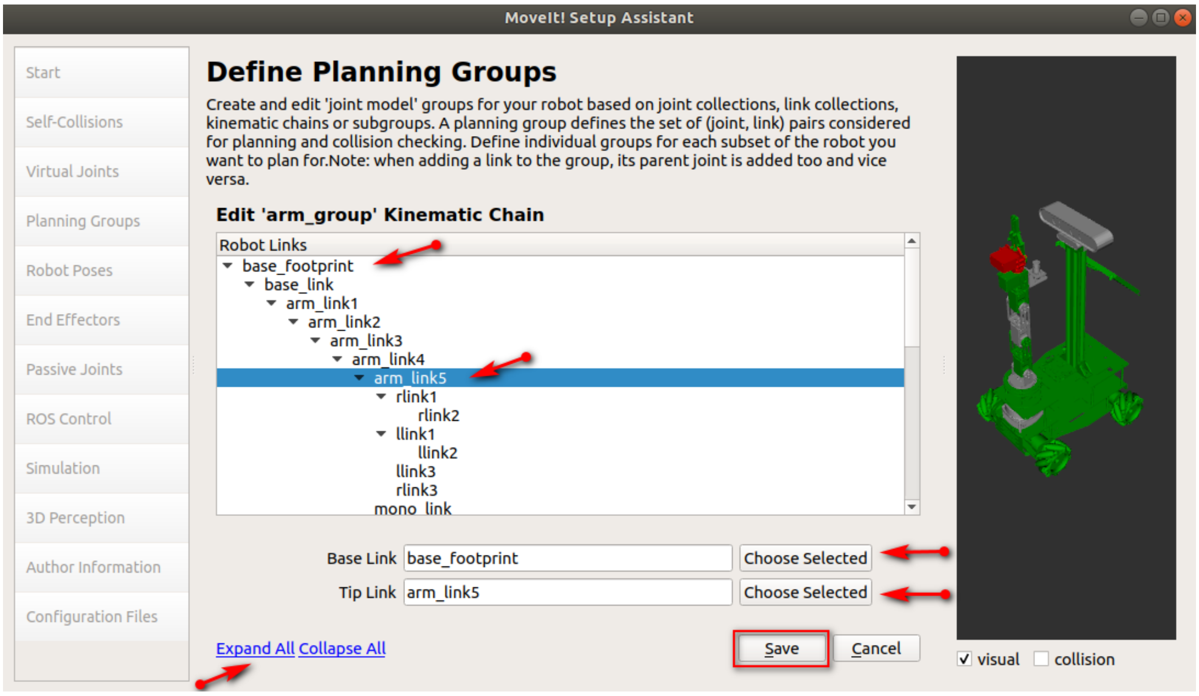
  Of course, you can also use other IK Solver, such as SRV or IK_FAST, or you can even develop a new Solver yourself and insert it.

- Kin. Search Resolution: Sampling density of joint space
- Kin. Search TImeout: Solving time. If the equipment performance is insufficient or there is no solution within the specified time in the actual application process, the time can be increased; for example, set to [0.1], [0.01].

Click [Add Kin.Chain] to add a joint chain.



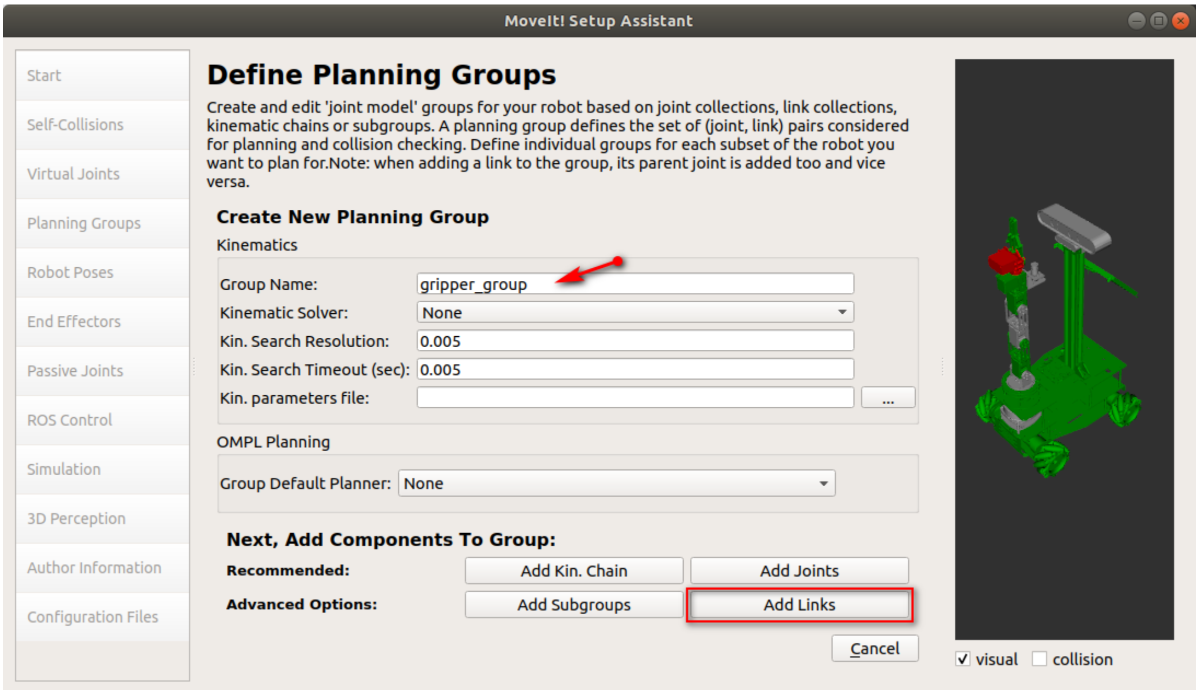

Click [Expand All], select Base Link as [base_footprint], and Tip Link as [arm_link5]; click [save] to save.



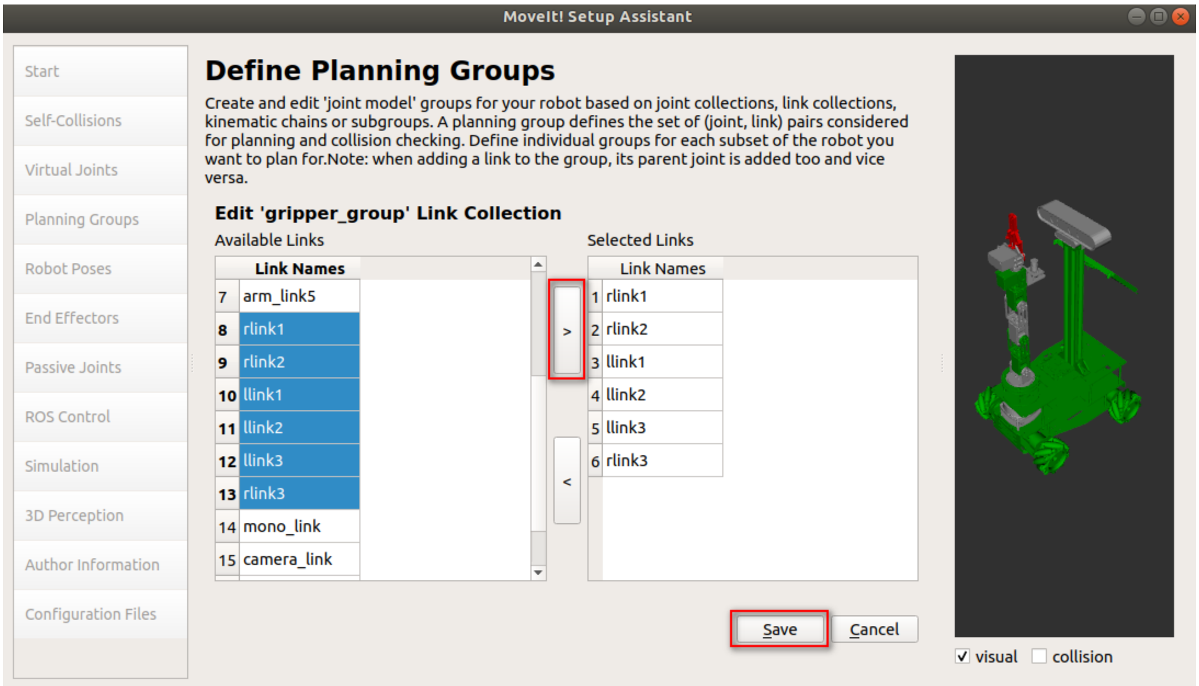

## 1.2.3.2. Add gripper planning group

Click [Add Group] to add a gripper planning group.

Create a group name and set it to [gripper_group]. There is no need to set up a kinematic solver; click [Add Links] to add the gripper link.



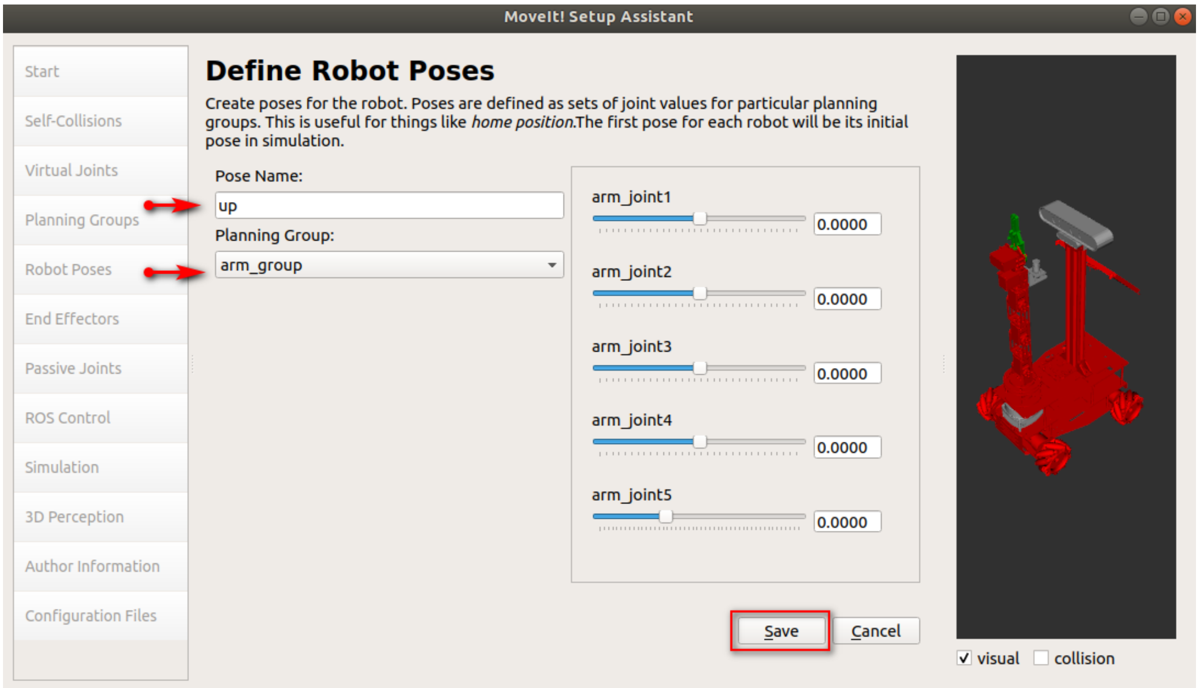

Select the connecting rod of the clamping jaw part, click [>], the right side will be added automatically, and click [Save] to save.



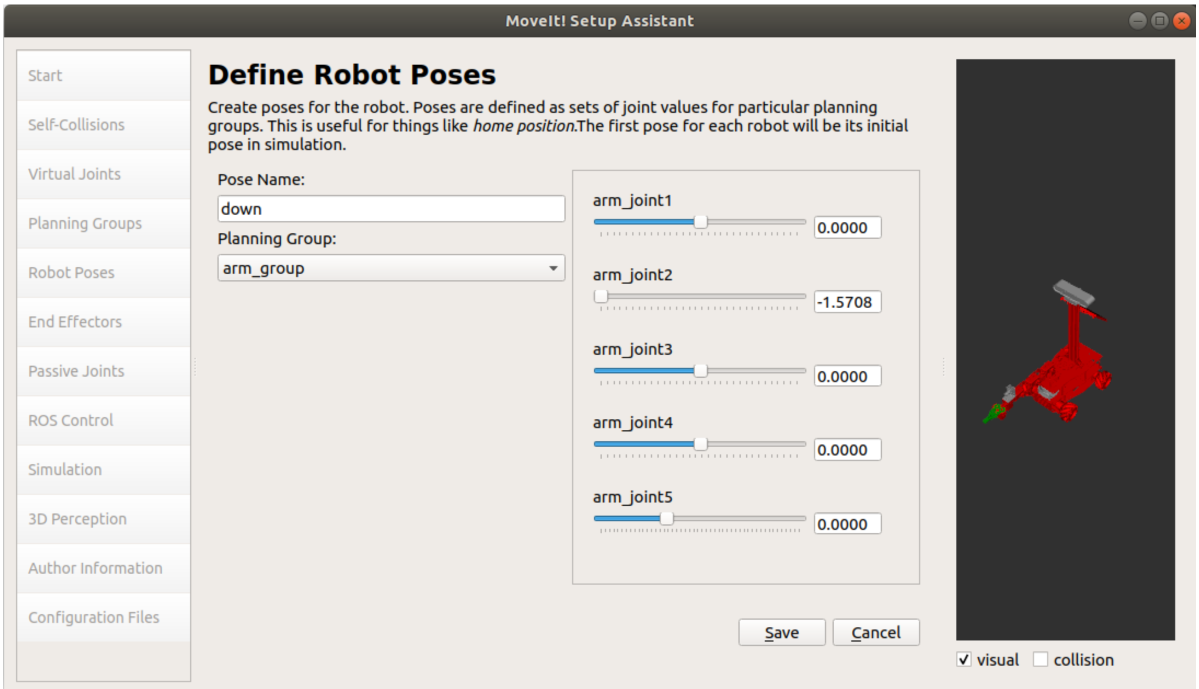

## 1.2.4. Create preset poses (Robot Poses)

Select [Robot Poses] and click [Add pose] to add a pose.

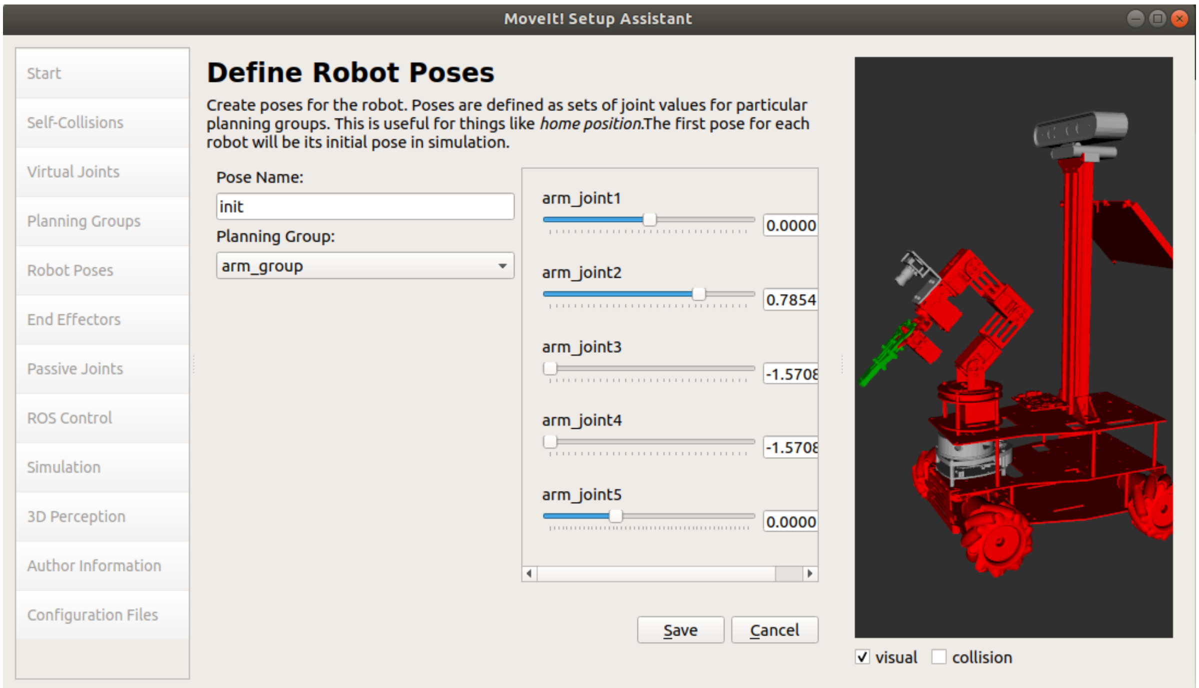
Add the robot arm posture, and set the posture name Pose Name to [up]



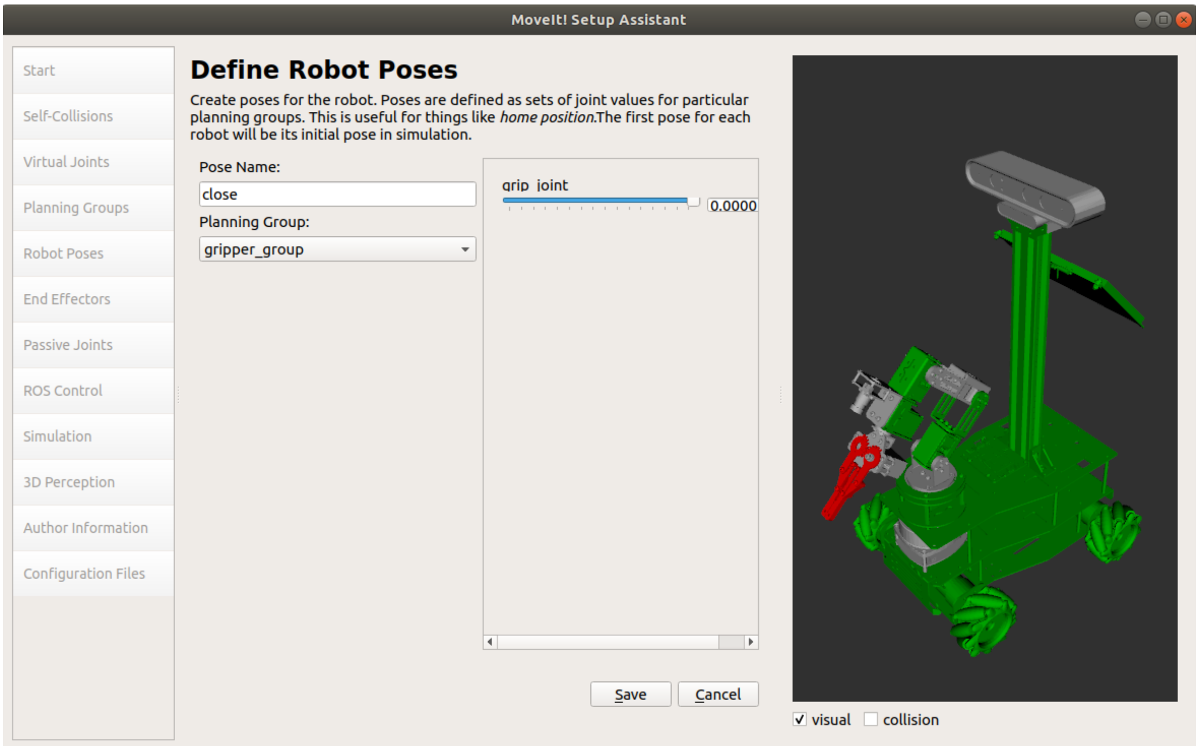

Add [down] gesture



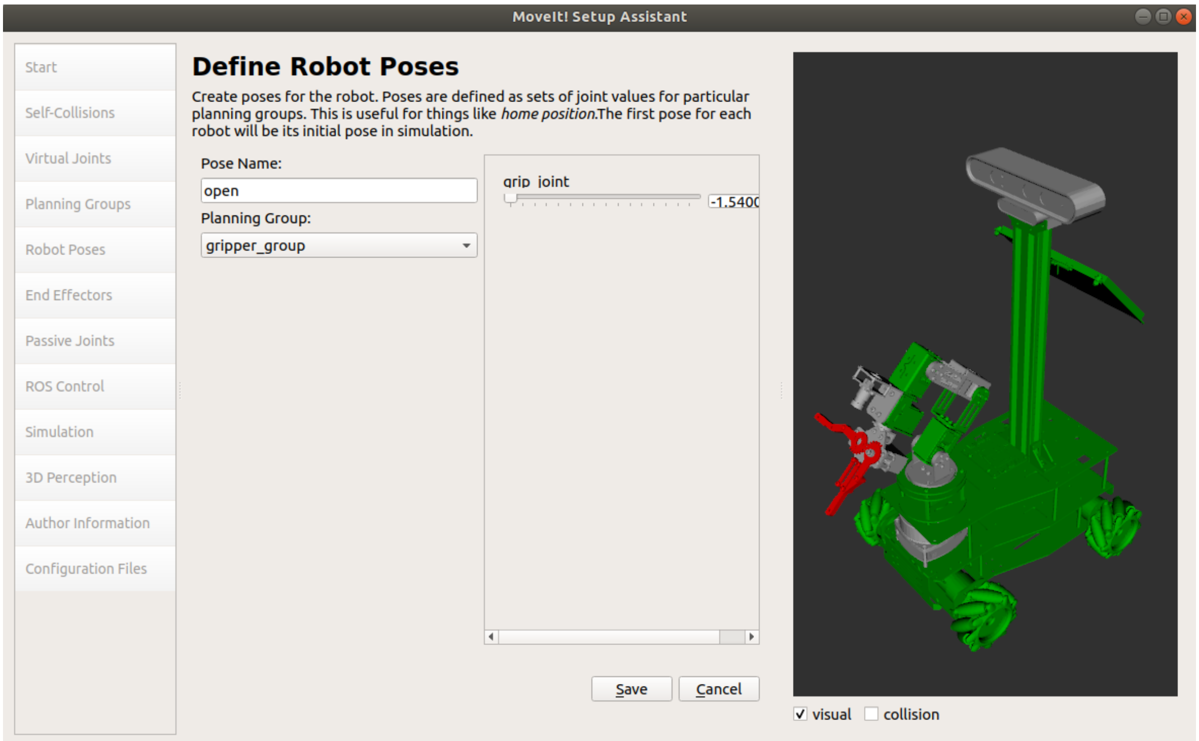

Add [init] gesture




Add the gripper [close] posture

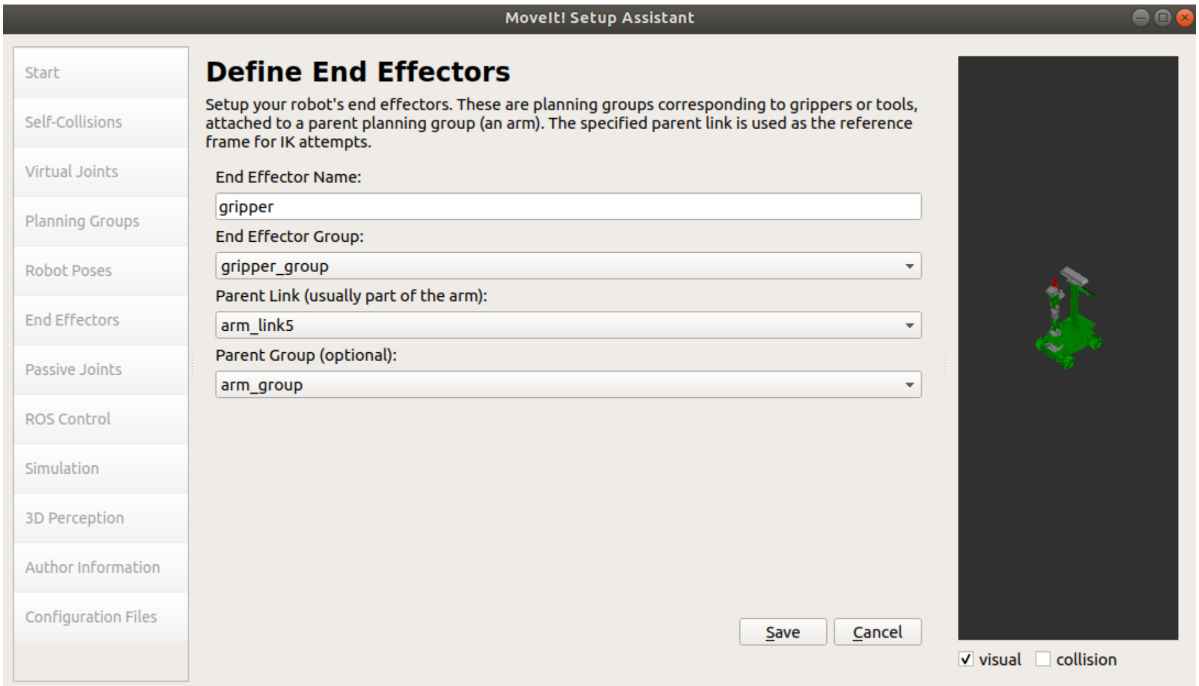



Add the gripper [open] posture



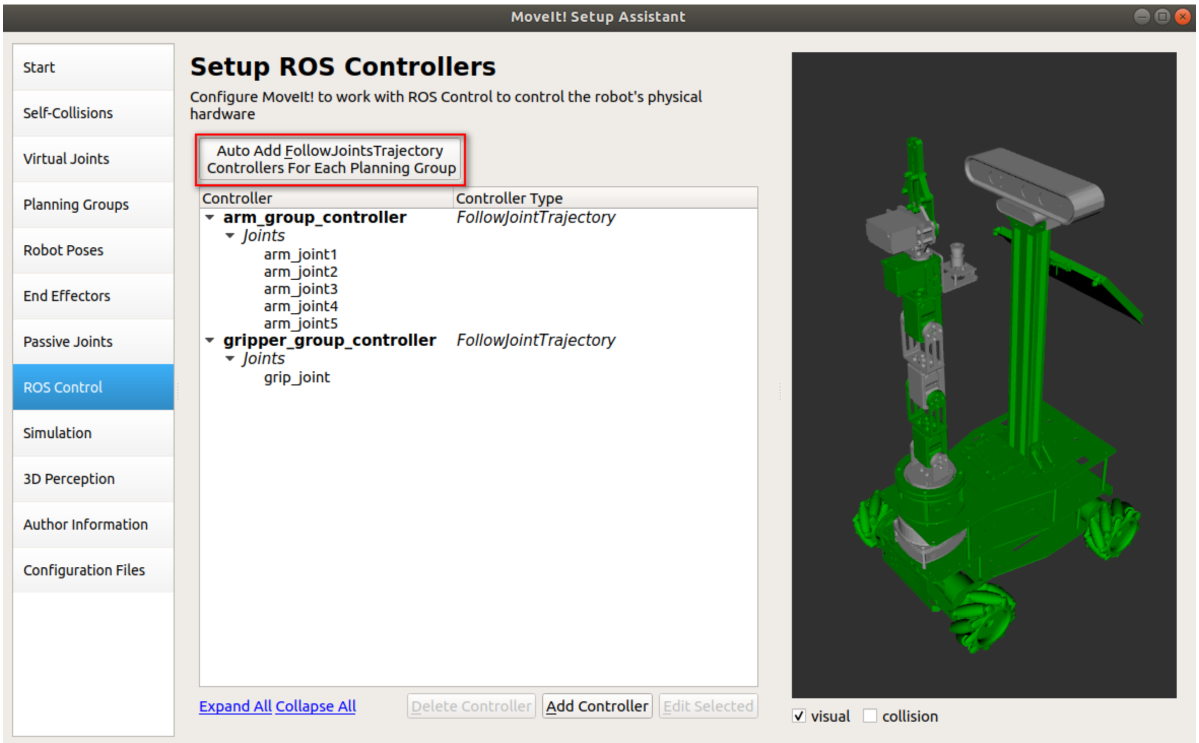

## 1.2.5. Set end influence joints

Select [End Effectors] and set as shown below




## 1.2.6. Establish ROS controller

Select [ROS Control] and click to automatically add the following joint trajectory

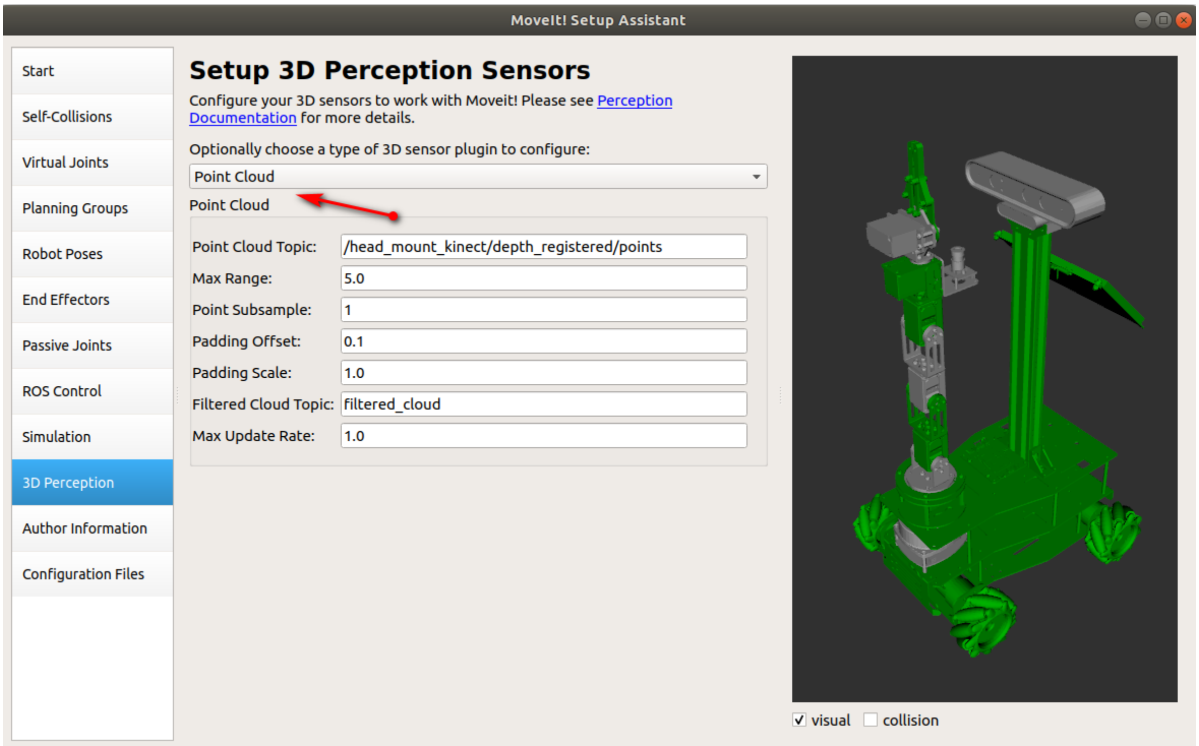



## 1.2.7. Add simulation

Select [Simulation] and click [Generate URDF]

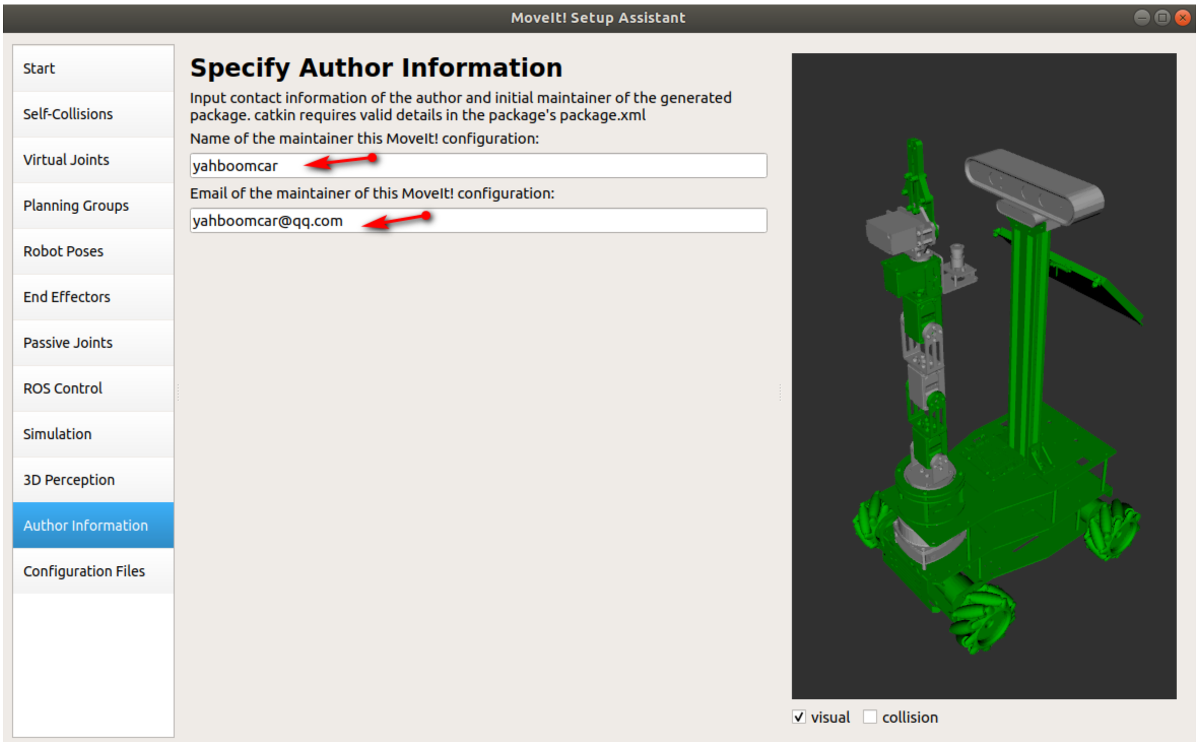

## 1.2.8. Add 3D information (optional)

Select [3D Perception] and select [Point Cloud].



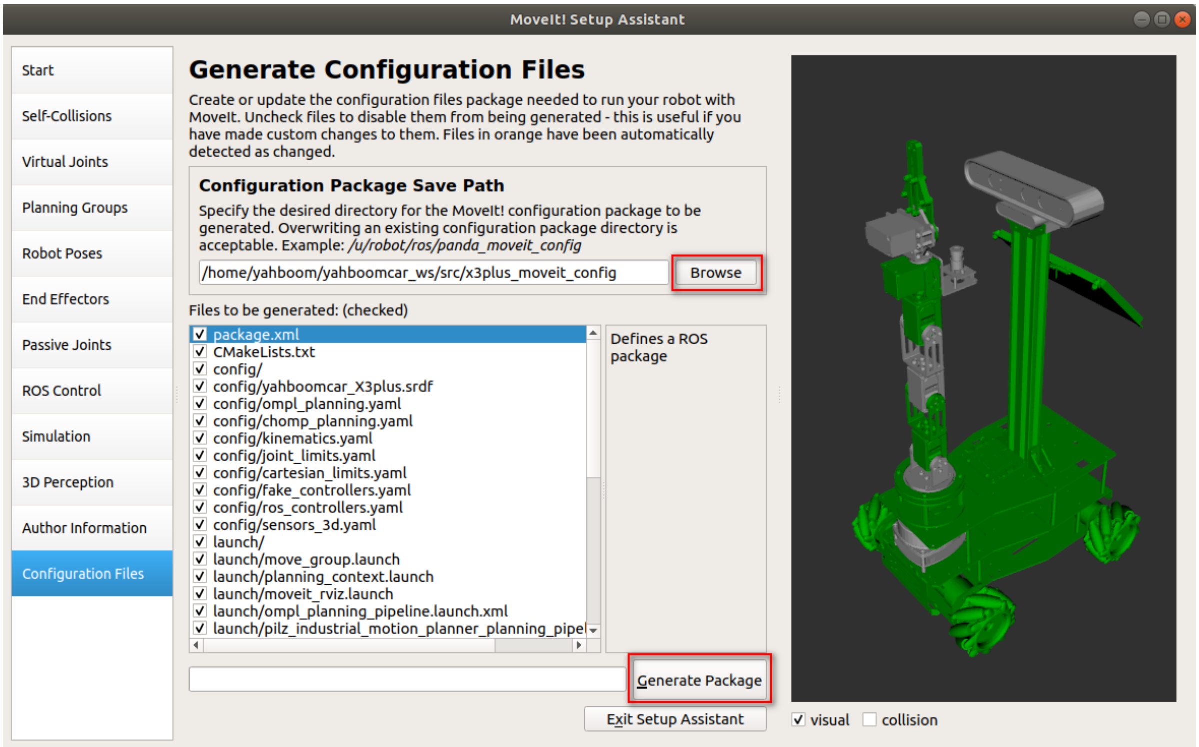

## 1.2.9. Add author information. If you don't add it, it will not be generated.

Select [Author Information] and add the following content.




## 1.2.10. Generate configuration file

Select [Configuration Files], click [Browse], select the [x3plus_moveit_config] folder (the folder must be empty), and click the [Generate Package] button to generate the configuration file. After completion, click [Exit Setup Assistant].




# 1.3. Detailed explanation of MoveIt configuration package

Open the [x3plus_moveit_config] folder we just created, and we find that there are two folders: config and launch.

## 1.3.1, config folder

- fake_controllers.yaml: This is a virtual controller configuration file that allows us to run MoveIt without a physical robot or even any simulator (such as gazebo) opened.
- joint_limits.yaml: This records the position, velocity and acceleration limits of each joint of the robot, which will be used in future planning.
- kinematics.yaml: something set by the motion planning group, used to initialize the kinematics solution library
- yahboomcar_X3plus.srdf: This is an important MoveIt configuration file.
- ompl_planning.yaml: Here are various parameters for configuring various OMPL algorithms.
- SRDF file: SRDF is the configuration file of moveit, used in conjunction with URDF. We can see that this is a configuration file in xml format. The root is robot and has an attribute name='yahboomcar_X3plus'. The following is what was just set in the Setup Assistant, including the definition of groups, poses, terminal controllers, virtual joints, and collision-free matrix ACM. Theoretically, as long as we have srdf and urdf, we can completely define a robot moveit information.

## 1.3.2, launch folder

- demo.launch: demo is the summary point of the operation. When we open it, we can see that it includes other launch files.
- move_group.launch: As the name suggests, the function of move group is to make a planning group move. The default is to use the ompl motion planning library. Others are to set some basic parameters and can be skipped for now.

- planning_context.launch: Here we can see that the urdf and srdf files used are defined, as well as the kinematics solution library. It is not recommended to change these manually, but if you need to use a different urdf, srdf, you can change it here.
- setup_assistant.launch: If you need to change some configuration, you can run it directly.

# 1.4. Configuration verification

Enter the workspace where the configuration file is located and execute the following command

```
cd ~/yahboomcar_ws # Enter the workspace
catkin_make # compile
source devel/setup.bash # Update system environment
roslaunch arm_moveit_demo x3plus_moveit_demo.launch sim:=true # Start moveIT
```

Examples are as follows