

SERO Robotersteuerung

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Chapter 1

Robotermodellierung MoveIt! Path Planning mit Gazebo

1.1 1. Clone git repository

```
git clone https://github.com/nils93/Robotermodellierung.git sero_ws && cd sero_ws
```

1.2 2. Start the setup.sh

```
./setup.sh
```

1.3 3. Enjoy the ultimate sero experience!

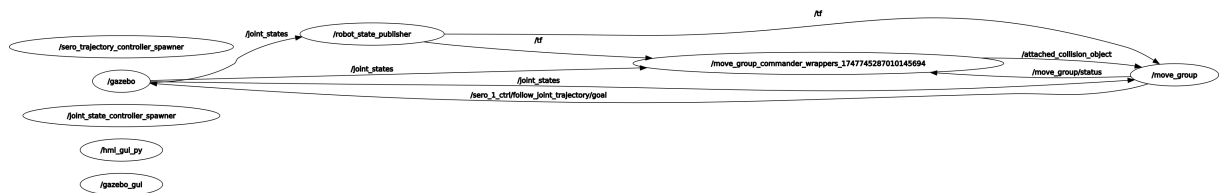
ROS Computation Graph

2.1 Description

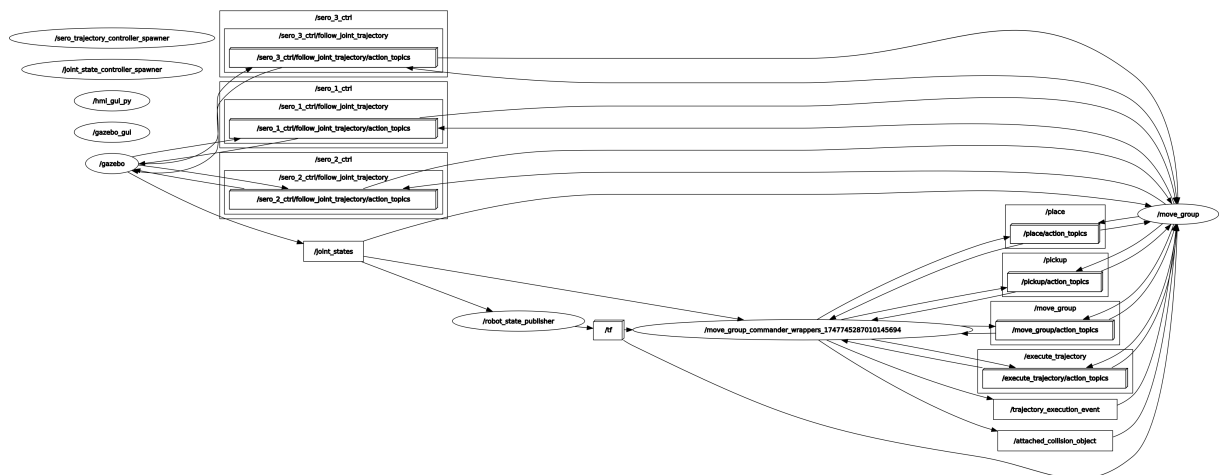
This overview shows how the main ROS components interact in the SERO robotic workcell:

- MoveIt planners
- HMI ImGui interface
- Controllers and robot descriptions
- Gazebo simulation

2.2 Simplified Graph (Nodes only)



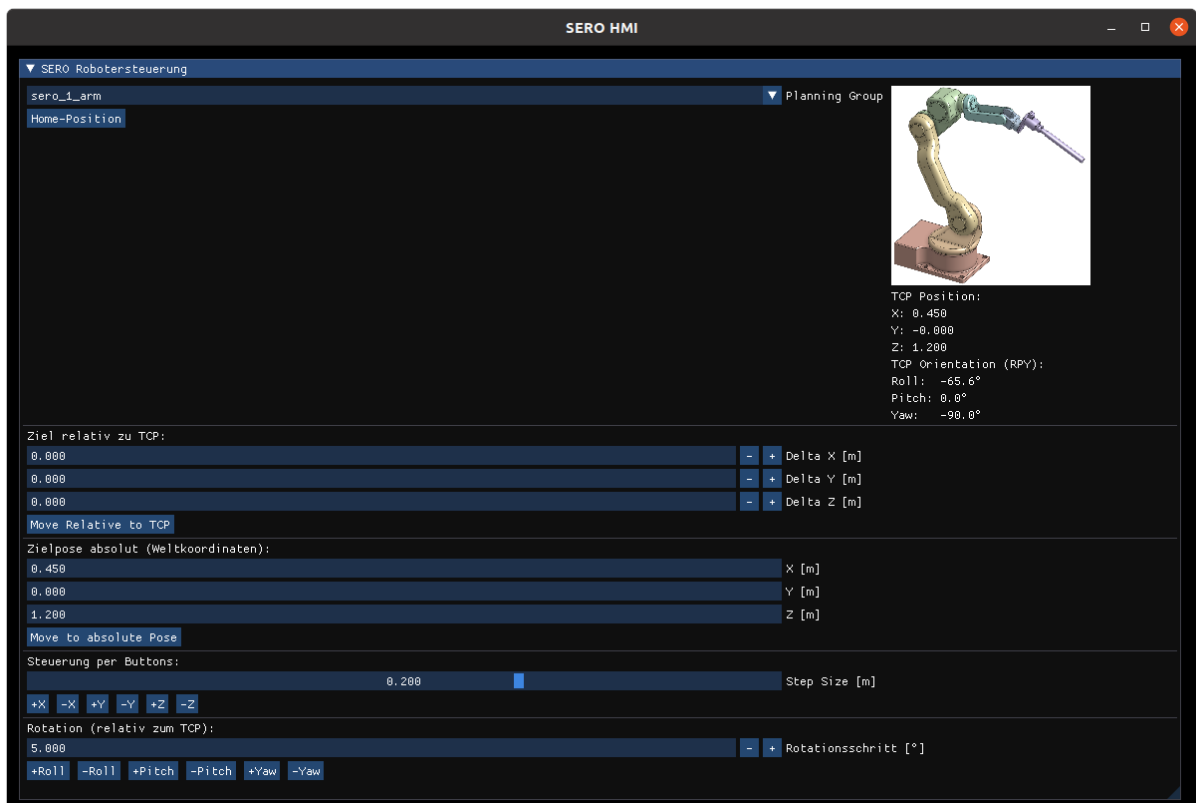
2.3 Full Computation Graph



Chapter 3

SERO HMI Interface

3.1 ImGui-Based GUI for Manual Robot Control



This image shows the graphical Human-Machine Interface (HMI) used to control the SERO robot arms. The GUI is implemented in Python using the ImGui library (pyimgui + OpenGL) and communicates with MoveIt via ROS.

Key elements:

- On the left: selection of the active planning group and a button to move to the predefined home pose.
- In the center: fields to define relative and absolute Cartesian motions (TCP-based).
- On the right: a live image of the selected robot, current TCP position, and movement confirmation.
- Below: button-based incremental movement in XYZ and RPY space.

The GUI is designed for real-time feedback and fast manual positioning during development and testing.

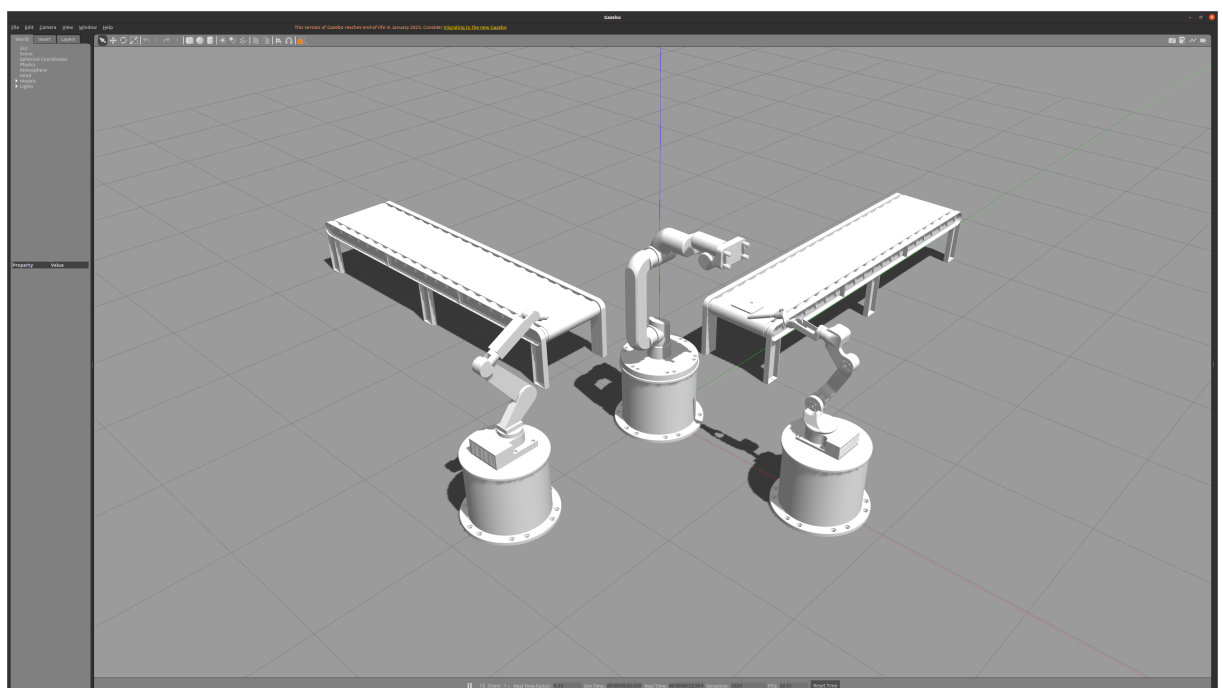
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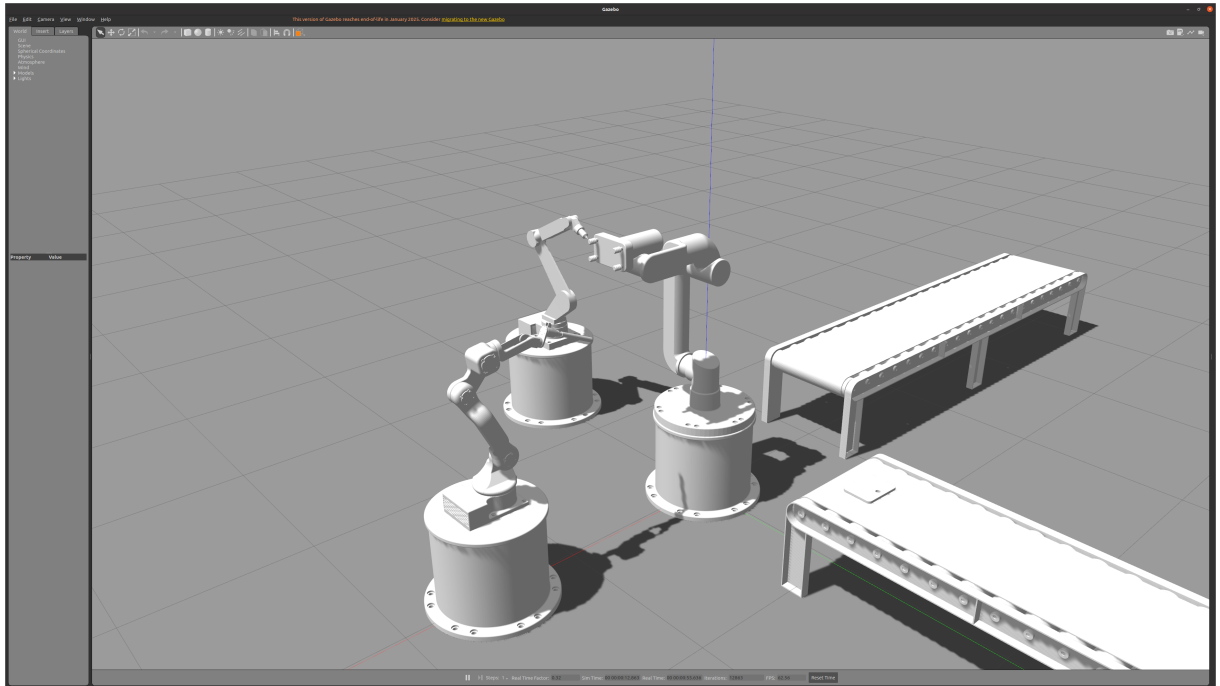
The Factory Station

4.1 Description

This overview shows our robotic station:

- Sero_1
- Sero_2
- Sero_3
- workobject





Chapter 5

Namespace Index

5.1 Namespace List

Here is a list of all namespaces with brief descriptions:

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path	23

Chapter 6

File Index

6.1 File List

Here is a list of all files with brief descriptions:

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Chapter 7

Namespace Documentation

7.1 better_path Namespace Reference

Functions

- def [move_to_absolute_pose](#) (group, pose)
- def [round_quaternion](#) (q, decimals=3)
- def [create_pose](#) (x, y, z, roll_deg=0, pitch_deg=0, yaw_deg=0)
- def [attach_object_to_tcp](#) (group, model_name="workobject")

Variables

- [anonymous](#)
- [sero_1](#) = moveit_commander.MoveGroupCommander("sero_1_arm")
- [sero_2](#) = moveit_commander.MoveGroupCommander("sero_2_arm")
- [sero_3](#) = moveit_commander.MoveGroupCommander("sero_3_arm")
- def [pose1_s3](#) = [create_pose](#)(x=0.0, y=1.1, z=0.7, roll_deg=0, pitch_deg=0, yaw_deg=0)
- def [pose2_s3](#) = [create_pose](#)(x=0.45, y=0.0, z=1.2, roll_deg=0, pitch_deg=0, yaw_deg=0)
- def [pose3_s3](#) = [create_pose](#)(x=0.0, y=-0.45, z=1.2, roll_deg=0, pitch_deg=0, yaw_deg=0)
- def [pose4_s3](#) = [create_pose](#)(x=-1, y=0.0, z=0.7, roll_deg=0, pitch_deg=0, yaw_deg=0)

7.1.1 Function Documentation

7.1.1.1 [attach_object_to_tcp\(\)](#)

```
def better_path.attach_object_to_tcp (
    group,
    model_name = "workobject" )
```

Fakes a grip by teleporting a Gazebo model to the robot's TCP pose.

7.1.1.2 create_pose()

```
def better_path.create_pose (
    x,
    y,
    z,
    roll_deg = 0,
    pitch_deg = 0,
    yaw_deg = 0 )
```

Here is the call graph for



7.1.1.3 move_to_absolute_pose()

```
def better_path.move_to_absolute_pose (
    group,
    pose )
```

7.1.1.4 round_quaternion()

```
def better_path.round_quaternion (
    q,
    decimals = 3 )
```

Here is the caller graph for



7.1.2 Variable Documentation

7.1.2.1 anonymous

```
better_path.anonymous
```

7.1.2.2 pose1_s3

```
def better_path.pose1_s3 = create_pose(x=0.0, y=1.1, z=0.7, roll_deg=0, pitch_deg=0, yaw_deg=0)
```

7.1.2.3 pose2_s3

```
def better_path.pose2_s3 = create_pose(x=0.45, y=0.0, z=1.2, roll_deg=0, pitch_deg=0, yaw_deg=0)
```

7.1.2.4 pose3_s3

```
def better_path.pose3_s3 = create_pose(x=0.0, y=-0.45, z=1.2, roll_deg=0, pitch_deg=0, yaw_deg=0)
```

7.1.2.5 pose4_s3

```
def better_path.pose4_s3 = create_pose(x=-1, y=0.0, z=0.7, roll_deg=0, pitch_deg=0, yaw_deg=0)
```

7.1.2.6 sero_1

```
better_path.sero_1 = moveit_commander.MoveGroupCommander("sero_1_arm")
```

7.1.2.7 sero_2

```
better_path.sero_2 = moveit_commander.MoveGroupCommander("sero_2_arm")
```

7.1.2.8 sero_3

```
better_path.sero_3 = moveit_commander.MoveGroupCommander("sero_3_arm")
```

7.2 hmi_gui Namespace Reference

Functions

- def `move_to_home` (`group_name`)
- def `move_relative_rpy` (`group`, `droll_deg`, `dpitch_deg`, `dyaw_deg`)
- def `move_relative` (`group`, `dx`, `dy`, `dz`)
- def `move_to_absolute_pose` (`group`, `pose`)
- def `load_texture_from_png` (`path`)

Variables

- list `planning_groups` = ["sero_1_arm", "sero_2_arm", "sero_3_arm"]
- list `tcp_links` = ["sero_1_tcp", "sero_2_tcp", "sero_3_tcp"]
- int `current_index` = 0
- `group` = moveit_commander.MoveGroupCommander(`planning_groups[current_index]`)
- float `relative_x` = 0.0
- float `relative_y` = 0.0
- float `relative_z` = 0.0
- float `step_size` = 0.2
- `window` = glfw.create_window(1400, 800, "SERO HMI", None, None)
- `impl` = GlfwRenderer(`window`)
- `pkg_dir` = os.path.dirname(os.path.abspath(__file__))
- dictionary `image_paths`
- dictionary `textures` = {}
- `tex_id`
- `width`
- `height`
- `changed`
- list `group_name` = `planning_groups[current_index]`
- list `current_group_name` = `planning_groups[current_index]`
- `w`
- `h`
- `current_pose` = `group.get_current_pose(tcp_links[current_index]).pose`
- `q` = `current_pose.orientation`
- `roll`
- `pitch`
- `yaw`
- int `eps` = 1e-2
- `step`
- `abs_pose` = Pose()
- `x`
- `y`
- `z`
- `orientation`
- list `move` = [0.0, 0.0, 0.0]
- `base_pose` = `group.get_current_pose(tcp_links[current_index]).pose`
- `target` = Pose()
- `success` = `group.plan()`
- `wait`
- float `rot_step` = 5.0
- list `rpy_move` = [0.0, 0.0, 0.0]

7.2.1 Function Documentation

7.2.1.1 load_texture_from_png()

```
def hmi_gui.load_texture_from_png (
    path )

@brief Loads a PNG image as an OpenGL texture for ImGui.

@param path Absolute path to the PNG image file.
@return (texture_id, width, height) tuple.
```

7.2.1.2 move_relative()

```
def hmi_gui.move_relative (
    group,
    dx,
    dy,
    dz )

@brief Moves the robot TCP relatively in Cartesian space.

@param group MoveGroupCommander instance.
@param dx Relative X offset in meters.
@param dy Relative Y offset in meters.
@param dz Relative Z offset in meters.
```

7.2.1.3 move_relative_rpy()

```
def hmi_gui.move_relative_rpy (
    group,
    droll_deg,
    dpitch_deg,
    dyaw_deg )

@brief Rotates the robot TCP relative to its current orientation.

@param group MoveGroupCommander instance.
@param droll_deg Roll offset in degrees.
@param dpitch_deg Pitch offset in degrees.
@param dyaw_deg Yaw offset in degrees.
```

7.2.1.4 move_to_absolute_pose()

```
def hmi_gui.move_to_absolute_pose (
    group,
    pose )

@brief Moves the robot TCP to a given absolute target pose.

@param group MoveGroupCommander instance.
@param pose Target geometry_msgs/Pose object in world coordinates.
```

7.2.1.5 move_to_home()

```
def hmi_gui.move_to_home (
    group_name )

@brief Moves the selected robot to its predefined home pose.

@param group_name Name of the MoveIt planning group (e.g. "sero_1_arm").
```

7.2.2 Variable Documentation

7.2.2.1 abs_pose

```
hmi_gui.abs_pose = Pose()
```

7.2.2.2 base_pose

```
hmi_gui.base_pose = group.get_current_pose(tcp_links[current_index]).pose
```

7.2.2.3 changed

```
hmi_gui.changed
```

7.2.2.4 current_group_name

```
list hmi_gui.current_group_name = planning\_groups[current\_index]
```

7.2.2.5 current_index

```
hmi_gui.current_index = 0
```

7.2.2.6 current_pose

```
hmi_gui.current_pose = group.get_current_pose(tcp\_links[current\_index]).pose
```

7.2.2.7 eps

```
int hmi_gui.eps = 1e-2
```

7.2.2.8 group

```
hmi_gui.group = moveit_commander.MoveGroupCommander(planning\_groups[current\_index])
```

7.2.2.9 group_name

```
list hmi_gui.group_name = planning\_groups[current\_index]
```

7.2.2.10 h

```
hmi_gui.h
```

7.2.2.11 height

```
hmi_gui.height
```

7.2.2.12 image_paths

dictionary hmi_gui.image_paths

Initial value:

```
1 = {
2     "sero_1_arm": os.path.join(pkg_dir, "../resources/sero_1_arm.png"),
3     "sero_2_arm": os.path.join(pkg_dir, "../resources/sero_2_arm.png"),
4     "sero_3_arm": os.path.join(pkg_dir, "../resources/sero_3_arm.png")
5 }
```

7.2.2.13 impl

hmi_gui.impl = GlfwRenderer([window](#))

7.2.2.14 move

list hmi_gui.move = [0.0, 0.0, 0.0]

7.2.2.15 orientation

hmi_gui.orientation

7.2.2.16 pitch

hmi_gui.pitch

7.2.2.17 pkg_dir

hmi_gui.pkg_dir = os.path.dirname(os.path.abspath(__file__))

7.2.2.18 planning_groups

list hmi_gui.planning_groups = ["sero_1_arm", "sero_2_arm", "sero_3_arm"]

7.2.2.19 q

```
hmi_gui.q = current_pose.orientation
```

7.2.2.20 relative_x

```
hmi_gui.relative_x = 0.0
```

7.2.2.21 relative_y

```
hmi_gui.relative_y = 0.0
```

7.2.2.22 relative_z

```
hmi_gui.relative_z = 0.0
```

7.2.2.23 roll

```
hmi_gui.roll
```

7.2.2.24 rot_step

```
hmi_gui.rot_step = 5.0
```

7.2.2.25 rpy_move

```
list hmi_gui.rpy_move = [0.0, 0.0, 0.0]
```

7.2.2.26 step

```
hmi_gui.step
```

7.2.2.27 step_size

```
hmi_gui.step_size = 0.2
```

7.2.2.28 success

```
hmi_gui.success = group.plan()
```

7.2.2.29 target

```
hmi_gui.target = Pose()
```

7.2.2.30 tcp_links

```
list hmi_gui.tcp_links = ["sero_1_tcp", "sero_2_tcp", "sero_3_tcp"]
```

7.2.2.31 tex_id

```
hmi_gui.tex_id
```

7.2.2.32 textures

```
dictionary hmi_gui.textures = {}
```

7.2.2.33 w

```
hmi_gui.w
```

7.2.2.34 wait

```
hmi_gui.wait
```

7.2.2.35 width

```
hmi_gui.width
```

7.2.2.36 window

```
hmi_gui.window = glfw.create_window(1400, 800, "SERO HMI", None, None)
```

7.2.2.37 x

```
hmi_gui.x
```

7.2.2.38 y

```
hmi_gui.y
```

7.2.2.39 yaw

```
hmi_gui.yaw
```

7.2.2.40 z

```
hmi_gui.z
```

7.3 path Namespace Reference

Functions

- def [abort_callback](#) (msg)
- def [move_to_named_target](#) (group_name, target_name)
- def [safe_call](#) (label, func)
- def [move_to_pose](#) (group_name, pose)
- def [move_to_position](#) (group_name, x, y, z)
- def [create_pose](#) (name, x, y, z, roll_deg, pitch_deg, yaw_deg)
- def [move_to_joint_positions_deg](#) (group_name, joint_values_deg)

Variables

- bool `abort_flag` = False
- `anonymous`
- `sero_1` = `moveit_commander.MoveGroupCommander("sero_1_arm")`
- `sero_2` = `moveit_commander.MoveGroupCommander("sero_2_arm")`
- `sero_3` = `moveit_commander.MoveGroupCommander("sero_3_arm")`
- list `poses_sero3`
- `p`

7.3.1 Function Documentation

7.3.1.1 `abort_callback()`

```
def path.abort_callback (
    msg )
```

7.3.1.2 `create_pose()`

```
def path.create_pose (
    name,
    x,
    y,
    z,
    roll_deg,
    pitch_deg,
    yaw_deg )
```

Creates and returns a `geometry_msgs Pose` from position and orientation (RPY in degrees).

7.3.1.3 `move_to_joint_positions_deg()`

```
def path.move_to_joint_positions_deg (
    group_name,
    joint_values_deg )
```

Moves the robot arm to specific joint positions given in degrees.

Args:

```
group_name (str): MoveIt planning group (e.g., "sero_1_arm")
joint_values_deg (list of float): Joint angles in degrees
```


7.3.1.4 move_to_named_target()

```
def path.move_to_named_target (
    group_name,
    target_name )
```

Moves the robot to a predefined named target (e.g., 'home') as set in the MoveIt Setup Assistant.

Args:

```
group_name (str): MoveIt planning group name (e.g., "sero_1_arm")
target_name (str): Name of the predefined pose (e.g., "home")
```

7.3.1.5 move_to_pose()

```
def path.move_to_pose (
    group_name,
    pose )
```

Plans and executes a motion to the specified pose using the given MoveIt group name. Includes retry logic, timeout extension, and planner fallback for better reliability.

7.3.1.6 move_to_position()

```
def path.move_to_position (
    group_name,
    x,
    y,
    z )
```

Moves the robot to a target position (x, y, z) with no strict orientation constraint, using `set_approximate_joint_value_target()` for better IK compatibility with KDL.

Args:

```
group_name (str): MoveIt planning group
x, y, z (float): Target position in meters
```

Returns:

```
bool: True if successful, False otherwise
```

7.3.1.7 safe_call()

```
def path.safe_call (
    label,
    func )
```

7.3.2 Variable Documentation

7.3.2.1 abort_flag

```
bool path.abort_flag = False
```

7.3.2.2 anonymous

```
path.anonymous
```

7.3.2.3 p

```
path.p
```

7.3.2.4 poses_sero3

```
list path.poses_sero3
```

Initial value:

```
1 = [  
2     create_pose("pose1", 0.0, 1.1, 0.7, 0, 0, 0),  
3     create_pose("pose2", 0.8, 0.0, 1.5, 0, 0, 0),  
4     create_pose("pose3", 0.0, -1.0, 1.5, 0, 0, 0),  
5     create_pose("pose4", -1.0, 0.0, 0.7, 0, 0, 0),  
6 ]
```

7.3.2.5 sero_1

```
path.sero_1 = moveit_commander.MoveGroupCommander("sero_1_arm")
```

7.3.2.6 sero_2

```
path.sero_2 = moveit_commander.MoveGroupCommander("sero_2_arm")
```

7.3.2.7 sero_3

```
path.sero_3 = moveit_commander.MoveGroupCommander("sero_3_arm")
```

Chapter 8

File Documentation

8.1 doc/gazebo_station.dox File Reference

8.2 doc/hmi_interface.dox File Reference

8.3 doc/ros_overview.dox File Reference

8.4 README.md File Reference

8.5 setup.sh File Reference

8.6 src/sero_hmi/CMakeLists.txt File Reference

8.7 src/sero_multi_station/CMakeLists.txt File Reference

8.8 src/sero_multi_station_moveit_config/CMakeLists.txt File Reference

Functions

- [cmake_minimum_required](#) (VERSION 3.1.3) project(sero_multi_station_moveit_config) find_package(catkin REQUIRED) catkin_package() install(DIRECTORY launch DESTINATION \$

8.8.1 Function Documentation

8.8.1.1 cmake_minimum_required()

```
cmake_minimum_required (
    VERSION 3.1.  3 )
```

8.9 src/station_peripherals/CMakeLists.txt File Reference

8.10 src/sero_hmi/package.xml File Reference

8.11 src/sero_multi_station/package.xml File Reference

8.12 src/sero_multi_station_moveit_config/package.xml File Reference

8.13 src/station_peripherals/package.xml File Reference

8.14 src/sero_hmi/scripts/hmi_gui.py File Reference

Namespaces

- [hmi_gui](#)

Functions

- def [hmi_gui.move_to_home](#) (group_name)
- def [hmi_gui.move_relative_rpy](#) (group, droll_deg, dpitch_deg, dyaw_deg)
- def [hmi_gui.move_relative](#) (group, dx, dy, dz)
- def [hmi_gui.move_to_absolute_pose](#) (group, pose)
- def [hmi_gui.load_texture_from_png](#) (path)

Variables

- list [hmi_gui.planning_groups](#) = ["sero_1_arm", "sero_2_arm", "sero_3_arm"]
- list [hmi_gui.tcp_links](#) = ["sero_1_tcp", "sero_2_tcp", "sero_3_tcp"]
- int [hmi_gui.current_index](#) = 0
- [hmi_gui.group](#) = moveit_commander.MoveGroupCommander(planning_groups[current_index])
- float [hmi_gui.relative_x](#) = 0.0
- float [hmi_gui.relative_y](#) = 0.0
- float [hmi_gui.relative_z](#) = 0.0
- float [hmi_gui.step_size](#) = 0.2
- [hmi_gui.window](#) = glfw.create_window(1400, 800, "SERO HMI", None, None)
- [hmi_gui.impl](#) = GlfwRenderer(window)
- [hmi_gui.pkg_dir](#) = os.path.dirname(os.path.abspath(__file__))
- dictionary [hmi_gui.image_paths](#)
- dictionary [hmi_gui.textures](#) = {}

- `hmi_gui.tex_id`
- `hmi_gui.width`
- `hmi_gui.height`
- `hmi_gui.changed`
- `list hmi_gui.group_name = planning_groups[current_index]`
- `list hmi_gui.current_group_name = planning_groups[current_index]`
- `hmi_gui.w`
- `hmi_gui.h`
- `hmi_gui.current_pose = group.get_current_pose(tcp_links[current_index]).pose`
- `hmi_gui.q = current_pose.orientation`
- `hmi_gui.roll`
- `hmi_gui.pitch`
- `hmi_gui.yaw`
- `int hmi_gui.eps = 1e-2`
- `hmi_gui.step`
- `hmi_gui.abs_pose = Pose()`
- `hmi_gui.x`
- `hmi_gui.y`
- `hmi_gui.z`
- `hmi_gui.orientation`
- `list hmi_gui.move = [0.0, 0.0, 0.0]`
- `hmi_gui.base_pose = group.get_current_pose(tcp_links[current_index]).pose`
- `hmi_gui.target = Pose()`
- `hmi_gui.success = group.plan()`
- `hmi_gui.wait`
- `float hmi_gui.rot_step = 5.0`
- `list hmi_gui.rpy_move = [0.0, 0.0, 0.0]`

- 8.15** `src/sero_multi_station/config/joint_state_controller.yaml` File Reference
- 8.16** `src/sero_multi_station/config/trajectory_controller.yaml` File Reference
- 8.17** `src/sero_multi_station/launch/bringup_moveit.launch` File Reference
- 8.18** `src/sero_multi_station/launch/bringup_moveit_just_sim.launch` File Reference
- 8.19** `src/sero_multi_station/launch/control_utils.launch` File Reference
- 8.20** `src/sero_multi_station/launch/factory_station.launch` File Reference
- 8.21** `src/sero_multi_station/launch/sero_multi_station_empty_world.launch` File Reference
- 8.22** `src/sero_multi_station/robot_description/sero_multi_station.urdf` File Reference
- 8.23** `src/sero_multi_station/scripts/better_path.py` File Reference

Namespaces

- [better_path](#)

Functions

- def [better_path.move_to_absolute_pose](#) (group, pose)
- def [better_path.round_quaternion](#) (q, decimals=3)
- def [better_path.create_pose](#) (x, y, z, roll_deg=0, pitch_deg=0, yaw_deg=0)
- def [better_path.attach_object_to_tcp](#) (group, model_name="workobject")

Variables

- [better_path.anonymous](#)
- [better_path.sero_1](#) = moveit_commander.MoveGroupCommander("sero_1_arm")
- [better_path.sero_2](#) = moveit_commander.MoveGroupCommander("sero_2_arm")
- [better_path.sero_3](#) = moveit_commander.MoveGroupCommander("sero_3_arm")
- [def better_path.pose1_s3](#) = create_pose(x=0.0, y=1.1, z=0.7, roll_deg=0, pitch_deg=0, yaw_deg=0)
- [def better_path.pose2_s3](#) = create_pose(x=0.45, y=0.0, z=1.2, roll_deg=0, pitch_deg=0, yaw_deg=0)
- [def better_path.pose3_s3](#) = create_pose(x=0.0, y=-0.45, z=1.2, roll_deg=0, pitch_deg=0, yaw_deg=0)
- [def better_path.pose4_s3](#) = create_pose(x=-1, y=0.0, z=0.7, roll_deg=0, pitch_deg=0, yaw_deg=0)

8.24 src/sero_multi_station/scripts/path.py File Reference

Namespaces

- [path](#)

Functions

- [def path.abort_callback](#) (msg)
- [def path.move_to_named_target](#) (group_name, target_name)
- [def path.safe_call](#) (label, func)
- [def path.move_to_pose](#) (group_name, pose)
- [def path.move_to_position](#) (group_name, x, y, z)
- [def path.create_pose](#) (name, x, y, z, roll_deg, pitch_deg, yaw_deg)
- [def path.move_to_joint_positions_deg](#) (group_name, joint_values_deg)

Variables

- [bool path.abort_flag](#) = False
- [path.anonymous](#)
- [path.sero_1](#) = moveit_commander.MoveGroupCommander("sero_1_arm")
- [path.sero_2](#) = moveit_commander.MoveGroupCommander("sero_2_arm")
- [path.sero_3](#) = moveit_commander.MoveGroupCommander("sero_3_arm")
- [list path.poses_sero3](#)
- [path.p](#)

8.25 src/sero_multi_station_moveit_config/config/cartesian_limits.yaml
File Reference

8.26 src/sero_multi_station_moveit_config/config/chomp_planning.yaml
File Reference

8.27 src/sero_multi_station_moveit_config/config/fake_controllers.yaml
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8.28 src/sero_multi_station_moveit_config/config/gazebo_↔
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8.29 src/sero_multi_station_moveit_config/config/joint_limits.yaml File
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8.31 src/sero_multi_station_moveit_config/config/ompl_planning.yaml
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8.32 src/sero_multi_station_moveit_config/config/ros_controllers.yaml
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8.33 src/sero_multi_station_moveit_config/config/sensors_3d.yaml File
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8.34 src/sero_multi_station_moveit_config/config/simple_moveit_↔
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8.37 src/sero_multi_station_moveit_config/launch/default_warehouse_↔
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8.38 src/sero_multi_station_moveit_config/launch/demo.launch File
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