

SERO Robotersteuerung

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1 Robotermodellierung Movelt! Path Planning mit Gazebo	1
1.1 1. Clone git repository	1
1.2 2. Start the setup.sh	1
1.3 3. Enjoy the ultimate sero experience!	1
2 ROS Computation Graph	3
2.1 Description	3
2.2 Simplified Graph (Nodes only)	3
2.3 Full Computation Graph	3
3 SERO HMI Interface	5
3.1 ImGui-Based GUI for Manual Robot Control	5
4 The Factory Station	7
4.1 Description	7
5 Namespace Index	9
5.1 Namespace List	9
6 File Index	11
6.1 File List	11
7 Namespace Documentation	13
7.1 hmi_gui Namespace Reference	13
7.1.1 Function Documentation	14
7.1.1.1 load_texture_from_png()	14
7.1.1.2 move_relative()	14
7.1.1.3 move_relative_rpy()	15
7.1.1.4 move_to_absolute_pose()	15
7.1.1.5 move_to_home()	15
7.1.2 Variable Documentation	15
7.1.2.1 abs_pose	15
7.1.2.2 base_pose	16
7.1.2.3 changed	16
7.1.2.4 current_group_name	16
7.1.2.5 current_index	16
7.1.2.6 current_pose	16
7.1.2.7 eps	16
7.1.2.8 group	16
7.1.2.9 group_name	16
7.1.2.10 h	17
7.1.2.11 height	17
7.1.2.12 image_paths	17
7.1.2.13 impl	17

7.1.2.14 move	17
7.1.2.15 orientation	17
7.1.2.16 pitch	17
7.1.2.17 pkg_dir	18
7.1.2.18 planning_groups	18
7.1.2.19 q	18
7.1.2.20 relative_x	18
7.1.2.21 relative_y	18
7.1.2.22 relative_z	18
7.1.2.23 roll	18
7.1.2.24 rot_step	18
7.1.2.25 rpy_move	19
7.1.2.26 step	19
7.1.2.27 step_size	19
7.1.2.28 success	19
7.1.2.29 target	19
7.1.2.30 tcp_links	19
7.1.2.31 tex_id	19
7.1.2.32 textures	19
7.1.2.33 w	20
7.1.2.34 wait	20
7.1.2.35 width	20
7.1.2.36 window	20
7.1.2.37 x	20
7.1.2.38 y	20
7.1.2.39 yaw	20
7.1.2.40 z	20
7.2 pathplanning Namespace Reference	21
7.2.1 Function Documentation	21
7.2.1.1 create_pose()	21
7.2.1.2 move_to_joint_positions_deg()	21
7.2.1.3 move_to_named_target()	22
7.2.1.4 move_to_pose()	22
7.2.1.5 move_to_position()	22
7.2.2 Variable Documentation	22
7.2.2.1 anonymous	22
7.3 pathplanning_cmd Namespace Reference	23
7.3.1 Function Documentation	23
7.3.1.1 move_to_position()	23
7.3.2 Variable Documentation	24
7.3.2.1 group_name	24
7.3.2.2 x	24

7.3.2.3 y	24
7.3.2.4 z	24
7.4 sero_multi_station Namespace Reference	24
7.4.1 Detailed Description	24
8 File Documentation	25
8.1 doc/gazebo_station.dox File Reference	25
8.2 doc/hmi_interface.dox File Reference	25
8.3 doc/ros_overview.dox File Reference	25
8.4 README.md File Reference	25
8.5 setup.sh File Reference	25
8.6 src/sero_hmi/CMakeLists.txt File Reference	25
8.7 src/sero_multi_station/CMakeLists.txt File Reference	25
8.8 src/sero_multi_station_moveit_config/CMakeLists.txt File Reference	25
8.8.1 Function Documentation	25
8.8.1.1 cmake_minimum_required()	26
8.9 src/station_peripherals/CMakeLists.txt File Reference	26
8.10 src/sero_hmi/package.xml File Reference	26
8.11 src/sero_multi_station/package.xml File Reference	26
8.12 src/sero_multi_station_moveit_config/package.xml File Reference	26
8.13 src/station_peripherals/package.xml File Reference	26
8.14 src/sero_hmi/scripts/hmi_gui.py File Reference	26
8.15 src/sero_multi_station/config/joint_state_controller.yaml File Reference	28
8.16 src/sero_multi_station/config/pid_gains.yaml File Reference	28
8.17 src/sero_multi_station/config/trajectory_controller.yaml File Reference	28
8.18 src/sero_multi_station/launch/bringup_moveit.launch File Reference	28
8.19 src/sero_multi_station/launch/bringup_moveit_just_sim.launch File Reference	28
8.20 src/sero_multi_station/launch/control_utils.launch File Reference	28
8.21 src/sero_multi_station/launch/factory_station.launch File Reference	28
8.22 src/sero_multi_station/launch/sero_multi_station_empty_world.launch File Reference	28
8.23 src/sero_multi_station/robot_description/sero_multi_station.urdf File Reference	28
8.24 src/sero_multi_station/scripts/pathplanning.py File Reference	28
8.25 src/sero_multi_station/scripts/pathplanning_cmd.py File Reference	29
8.26 src/sero_multi_station_moveit_config/config/cartesian_limits.yaml File Reference	31
8.27 src/sero_multi_station_moveit_config/config/chomp_planning.yaml File Reference	31
8.28 src/sero_multi_station_moveit_config/config/fake_controllers.yaml File Reference	31
8.29 src/sero_multi_station_moveit_config/config/gazebo_controllers.yaml File Reference	31
8.30 src/sero_multi_station_moveit_config/config/joint_limits.yaml File Reference	31
8.31 src/sero_multi_station_moveit_config/config/kinematics.yaml File Reference	31
8.32 src/sero_multi_station_moveit_config/config/ompl_planning.yaml File Reference	31
8.33 src/sero_multi_station_moveit_config/config/ros_controllers.yaml File Reference	31
8.34 src/sero_multi_station_moveit_config/config/sensors_3d.yaml File Reference	31

8.35 src/sero_multi_station_moveit_config/config/simple_moveit_controllers.yaml File Reference	31
8.36 src/sero_multi_station_moveit_config/config/stomp_planning.yaml File Reference	31
8.37 src/sero_multi_station_moveit_config/launch/chomp_planning_pipeline.launch.xml File Reference	31
8.38 src/sero_multi_station_moveit_config/launch/default_warehouse_db.launch File Reference	31
8.39 src/sero_multi_station_moveit_config/launch/demo.launch File Reference	31
8.40 src/sero_multi_station_moveit_config/launch/demo_gazebo.launch File Reference	31
8.41 src/sero_multi_station_moveit_config/launch/fake_moveit_controller_manager.launch.xml File Reference	31
8.42 src/sero_multi_station_moveit_config/launch/gazebo.launch File Reference	31
8.43 src/sero_multi_station_moveit_config/launch/joystick_control.launch File Reference	31
8.44 src/sero_multi_station_moveit_config/launch/move_group.launch File Reference	31
8.45 src/sero_multi_station_moveit_config/launch/moveit_rviz.launch File Reference	31
8.46 src/sero_multi_station_moveit_config/launch/ompl-chomp_planning_pipeline.launch.xml File Reference	31
8.47 src/sero_multi_station_moveit_config/launch/ompl_planning_pipeline.launch.xml File Reference	31
8.48 src/sero_multi_station_moveit_config/launch/pilz_industrial_motion_planner_planning_pipeline.launch.xml File Reference	31
8.49 src/sero_multi_station_moveit_config/launch/planning_context.launch File Reference	31
8.50 src/sero_multi_station_moveit_config/launch/planning_pipeline.launch.xml File Reference	31
8.51 src/sero_multi_station_moveit_config/launch/ros_control_moveit_controller_manager.launch.xml File Reference	31
8.52 src/sero_multi_station_moveit_config/launch/ros_controllers.launch File Reference	31
8.53 src/sero_multi_station_moveit_config/launch/run_benchmark_ompl.launch File Reference	31
8.54 src/sero_multi_station_moveit_config/launch/sensor_manager.launch.xml File Reference	31
8.55 src/sero_multi_station_moveit_config/launch/sero_multi_station_moveit_sensor_manager.launch.xml File Reference	31
8.56 src/sero_multi_station_moveit_config/launch/setup_assistant.launch File Reference	31
8.57 src/sero_multi_station_moveit_config/launch/simple_moveit_controller_manager.launch.xml File Reference	31
8.58 src/sero_multi_station_moveit_config/launch/stomp_planning_pipeline.launch.xml File Reference	31
8.59 src/sero_multi_station_moveit_config/launch/trajectory_execution.launch.xml File Reference	31
8.60 src/sero_multi_station_moveit_config/launch/warehouse.launch File Reference	31
8.61 src/sero_multi_station_moveit_config/launch/warehouse_settings.launch.xml File Reference	31
8.62 src/station_peripherals/launch/station_peripherals.launch File Reference	31
8.63 src/station_peripherals/urdf/conveyor_belt_1.urdf File Reference	31
8.64 src/station_peripherals/urdf/conveyor_belt_2.urdf File Reference	31
8.65 src/station_peripherals/urdf/sero_1_socket.urdf File Reference	31
8.66 src/station_peripherals/urdf/sero_2_socket.urdf File Reference	31
8.67 src/station_peripherals/urdf/sero_3_socket.urdf File Reference	31
8.68 src/station_peripherals/urdf/workobject.urdf File Reference	31

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!

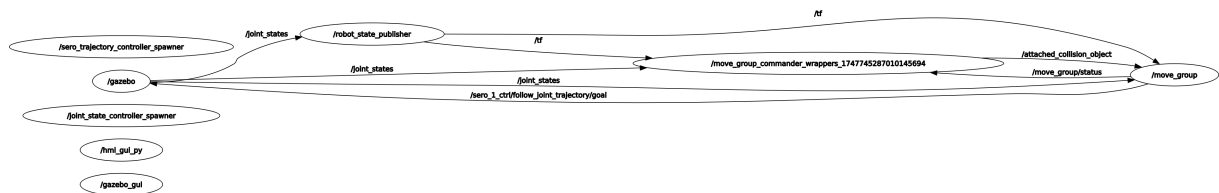
ROS Computation Graph

2.1 Description

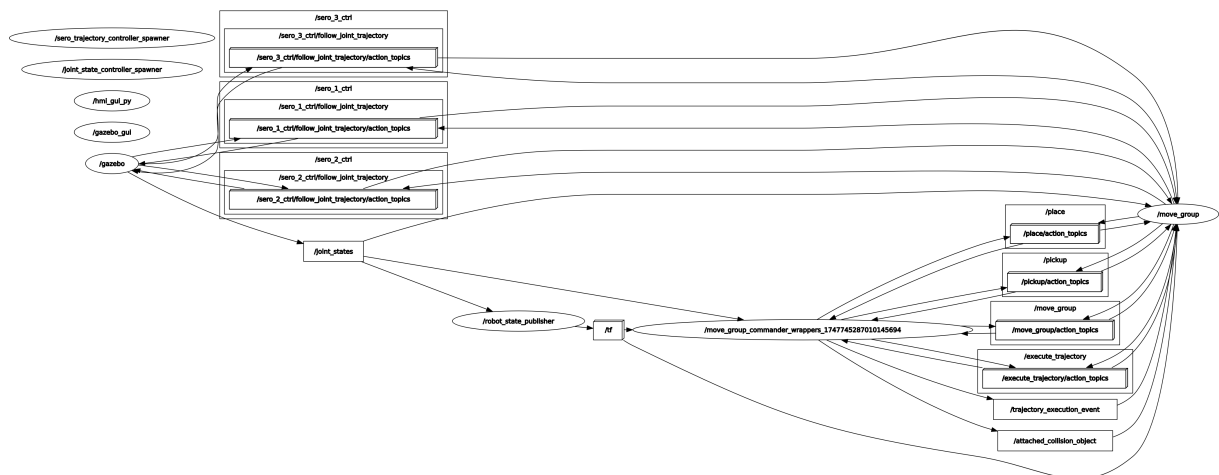
This overview shows how the main ROS components interact in the SERO robotic workcell:

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

2.2 Simplified Graph (Nodes only)



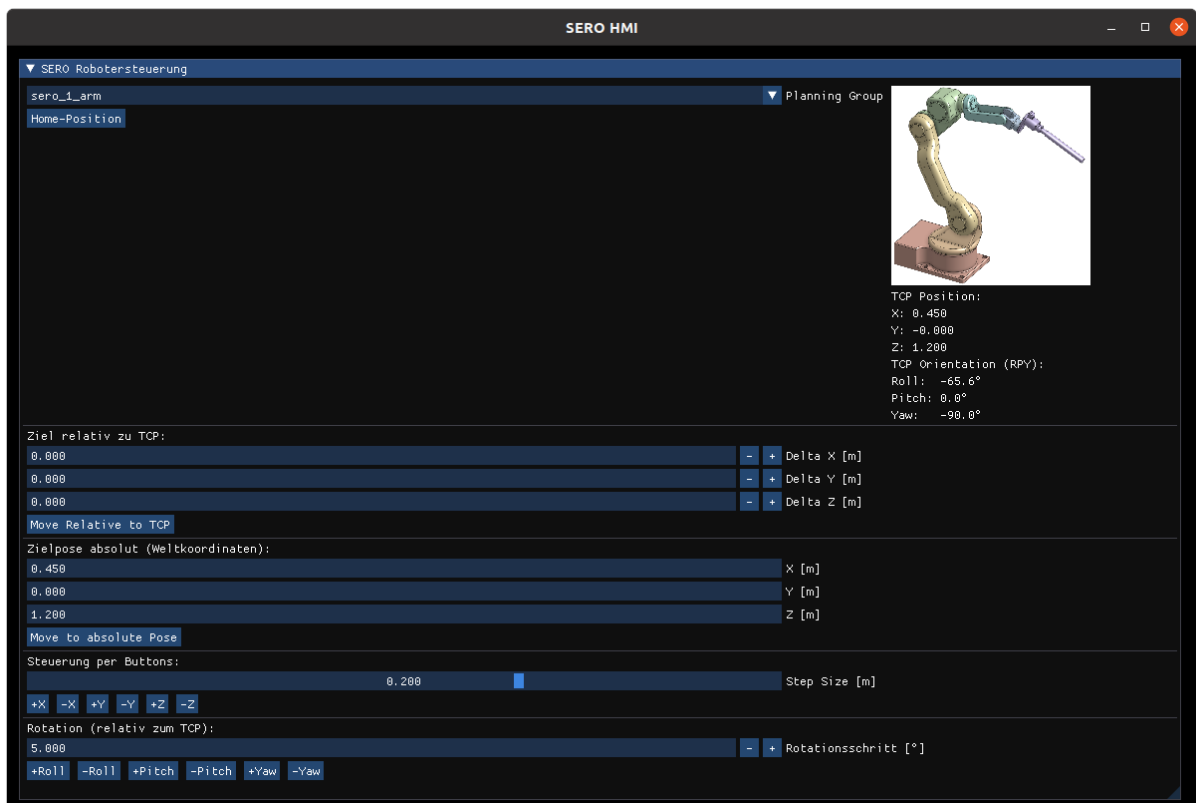
2.3 Full Computation Graph



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.

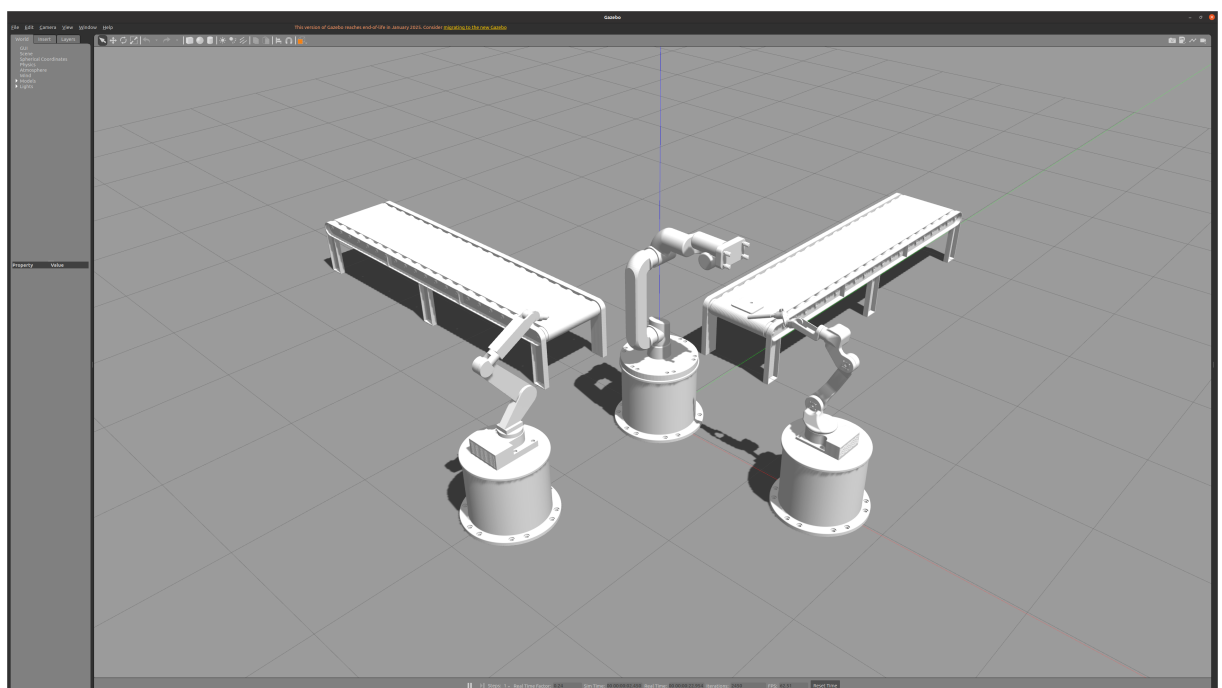
Chapter 4

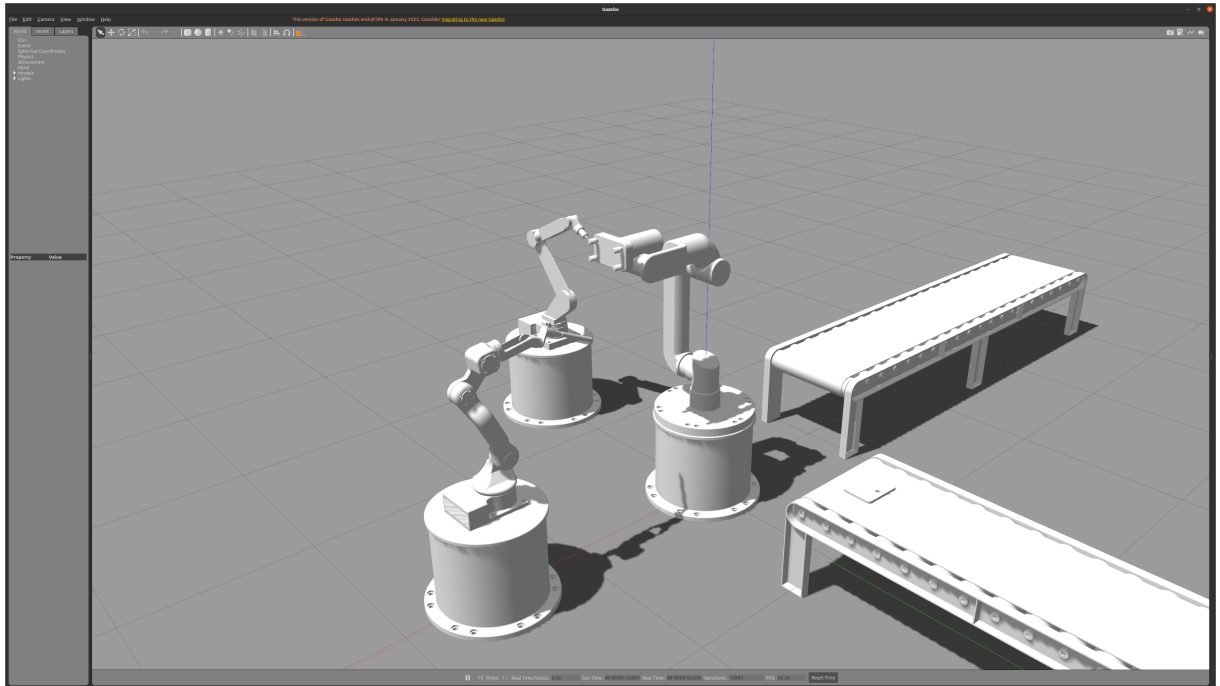
The Factory Station

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:

hmi_gui	13
pathplanning	21
pathplanning_cmd	23
sero_multi_station	
Moves a robot arm between predefined named targets and optionally to custom poses, positions, or joint configurations	24

Chapter 6

File Index

6.1 File List

Here is a list of all files with brief descriptions:

setup.sh	25
src/sero_hmi/ package.xml	26
src/sero_hmi/scripts/ hmi_gui.py	26
src/sero_multi_station/ package.xml	26
src/sero_multi_station/config/ joint_state_controller.yaml	28
src/sero_multi_station/config/ pid_gains.yaml	28
src/sero_multi_station/config/ trajectory_controller.yaml	28
src/sero_multi_station/launch/ bringup_moveit.launch	28
src/sero_multi_station/launch/ bringup_moveit_just_sim.launch	28
src/sero_multi_station/launch/ control_utils.launch	28
src/sero_multi_station/launch/ factory_station.launch	28
src/sero_multi_station/launch/ sero_multi_station_empty_world.launch	28
src/sero_multi_station/robot_description/ sero_multi_station.urdf	28
src/sero_multi_station/scripts/ pathplanning.py	28
src/sero_multi_station/scripts/ pathplanning_cmd.py	29
src/sero_multi_station_moveit_config/ package.xml	26
src/sero_multi_station_moveit_config/config/ cartesian_limits.yaml	31
src/sero_multi_station_moveit_config/config/ chomp_planning.yaml	31
src/sero_multi_station_moveit_config/config/ fake_controllers.yaml	31
src/sero_multi_station_moveit_config/config/ gazebo_controllers.yaml	31
src/sero_multi_station_moveit_config/config/ joint_limits.yaml	31
src/sero_multi_station_moveit_config/config/ kinematics.yaml	31
src/sero_multi_station_moveit_config/config/ ompl_planning.yaml	31
src/sero_multi_station_moveit_config/config/ ros_controllers.yaml	31
src/sero_multi_station_moveit_config/config/ sensors_3d.yaml	31
src/sero_multi_station_moveit_config/config/ simple_moveit_controllers.yaml	31
src/sero_multi_station_moveit_config/config/ stomp_planning.yaml	31
src/sero_multi_station_moveit_config/launch/ chomp_planning_pipeline.launch.xml	31
src/sero_multi_station_moveit_config/launch/ default_warehouse_db.launch	31
src/sero_multi_station_moveit_config/launch/ demo.launch	31
src/sero_multi_station_moveit_config/launch/ demo_gazebo.launch	31
src/sero_multi_station_moveit_config/launch/ fake_moveit_controller_manager.launch.xml	31
src/sero_multi_station_moveit_config/launch/ gazebo.launch	31
src/sero_multi_station_moveit_config/launch/ joystick_control.launch	31
src/sero_multi_station_moveit_config/launch/ move_group.launch	31

src/sero_multi_station_moveit_config/launch/ moveit_rviz.launch	31
src/sero_multi_station_moveit_config/launch/ ompl-chomp_planning_pipeline.launch.xml	31
src/sero_multi_station_moveit_config/launch/ ompl_planning_pipeline.launch.xml	31
src/sero_multi_station_moveit_config/launch/ pilz_industrial_motion_planner_planning_pipeline.launch.xml	31
src/sero_multi_station_moveit_config/launch/ planning_context.launch	31
src/sero_multi_station_moveit_config/launch/ planning_pipeline.launch.xml	31
src/sero_multi_station_moveit_config/launch/ ros_control_moveit_controller_manager.launch.xml	31
src/sero_multi_station_moveit_config/launch/ ros_controllers.launch	31
src/sero_multi_station_moveit_config/launch/ run_benchmark_ompl.launch	31
src/sero_multi_station_moveit_config/launch/ sensor_manager.launch.xml	31
src/sero_multi_station_moveit_config/launch/ sero_multi_station_moveit_sensor_manager.launch.xml	31
src/sero_multi_station_moveit_config/launch/ setup_assistant.launch	31
src/sero_multi_station_moveit_config/launch/ simple_moveit_controller_manager.launch.xml	31
src/sero_multi_station_moveit_config/launch/ stomp_planning_pipeline.launch.xml	31
src/sero_multi_station_moveit_config/launch/ trajectory_execution.launch.xml	31
src/sero_multi_station_moveit_config/launch/ warehouse.launch	31
src/sero_multi_station_moveit_config/launch/ warehouse_settings.launch.xml	31
src/station_peripherals/ package.xml	26
src/station_peripherals/launch/ station_peripherals.launch	31
src/station_peripherals/urdf/ conveyor_belt_1.urdf	31
src/station_peripherals/urdf/ conveyor_belt_2.urdf	31
src/station_peripherals/urdf/ sero_1_sockel.urdf	31
src/station_peripherals/urdf/ sero_2_sockel.urdf	31
src/station_peripherals/urdf/ sero_3_sockel.urdf	31
src/station_peripherals/urdf/ workobject.urdf	31

Chapter 7

Namespace Documentation

7.1 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]`

7.1.1 Function Documentation

7.1.1.1 `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.
```

7.1.1.2 `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.
```

7.1.1.3 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.
```

7.1.1.4 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.
```

7.1.1.5 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_l_arm").
```

7.1.2 Variable Documentation

7.1.2.1 abs_pose

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

7.1.2.2 base_pose

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

7.1.2.3 changed

```
hmi_gui.changed
```

7.1.2.4 current_group_name

```
list hmi_gui.current_group_name = planning_groups[current_index]
```

7.1.2.5 current_index

```
hmi_gui.current_index = 0
```

7.1.2.6 current_pose

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

7.1.2.7 eps

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

7.1.2.8 group

```
hmi_gui.group = moveit_commander.MoveGroupCommander(planning_groups[current_index])
```

7.1.2.9 group_name

```
list hmi_gui.group_name = planning_groups[current_index]
```

7.1.2.10 h

hmi_gui.h

7.1.2.11 height

hmi_gui.height

7.1.2.12 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 }
```

7.1.2.13 impl

hmi_gui.impl = GlfwRenderer(window)

7.1.2.14 move

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

7.1.2.15 orientation

hmi_gui.orientation

7.1.2.16 pitch

hmi_gui.pitch

7.1.2.17 pkg_dir

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

7.1.2.18 planning_groups

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

7.1.2.19 q

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

7.1.2.20 relative_x

```
hmi_gui.relative_x = 0.0
```

7.1.2.21 relative_y

```
hmi_gui.relative_y = 0.0
```

7.1.2.22 relative_z

```
hmi_gui.relative_z = 0.0
```

7.1.2.23 roll

```
hmi_gui.roll
```

7.1.2.24 rot_step

```
hmi_gui.rot_step = 5.0
```


7.1.2.25 rpy_move

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

7.1.2.26 step

```
hmi_gui.step
```

7.1.2.27 step_size

```
hmi_gui.step_size = 0.2
```

7.1.2.28 success

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

7.1.2.29 target

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

7.1.2.30 tcp_links

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

7.1.2.31 tex_id

```
hmi_gui.tex_id
```

7.1.2.32 textures

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

7.1.2.33 w

`hmi_gui.w`

7.1.2.34 wait

`hmi_gui.wait`

7.1.2.35 width

`hmi_gui.width`

7.1.2.36 window

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

7.1.2.37 x

`hmi_gui.x`

7.1.2.38 y

`hmi_gui.y`

7.1.2.39 yaw

`hmi_gui.yaw`

7.1.2.40 z

`hmi_gui.z`

7.2 pathplanning Namespace Reference

Functions

- def [move_to_named_target](#) (group_name, target_name)
- 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

- [anonymous](#)

7.2.1 Function Documentation

7.2.1.1 [create_pose\(\)](#)

```
def pathplanning.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).
 @param name Optional label for logging
 @param x,y,z Cartesian coordinates
 @param roll_deg, pitch_deg, yaw_deg Orientation in degrees
 @return geometry_msgs.msg.Pose

7.2.1.2 [move_to_joint_positions_deg\(\)](#)

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

Moves the robot arm to specific joint positions given in degrees.
 @param group_name MoveIt planning group
 @param joint_values_deg List of joint angles in degrees

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

7.2.1.3 move_to_named_target()

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

Moves the robot to a predefined named target.
 @param group_name MoveIt group name (e.g. "sero_l_arm")
 @param target_name Name of the predefined target

7.2.1.4 move_to_pose()

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

Plans and executes a motion to the specified absolute pose.
 @param group_name MoveIt group name
 @param pose Target pose as geometry_msgs/Pose

7.2.1.5 move_to_position()

```
def pathplanning.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.

@param group_name MoveIt group
 @param x X position [m]
 @param y Y position [m]
 @param z Z position [m]
 Args:
 group_name (str): MoveIt planning group
 x, y, z (float): Target position in meters

Returns:
 bool: True if successful, False otherwise

7.2.2 Variable Documentation

7.2.2.1 anonymous

```
pathplanning.anonymous
```

7.3 pathplanning_cmd Namespace Reference

Functions

- `def move_to_position (group_name, x, y, z)`
Moves the specified MoveIt group to a 3D target position (x, y, z).

Variables

- `group_name = sys.argv[1]`
- `x = float(sys.argv[2])`
- `y = float(sys.argv[3])`
- `z = float(sys.argv[4])`

7.3.1 Function Documentation

7.3.1.1 move_to_position()

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

Moves the specified MoveIt group to a 3D target position (x, y, z).

Parameters

<i>group_name</i>	Name of the MoveIt planning group (e.g., "sero_3_arm").
<i>x</i>	X-coordinate in meters
<i>y</i>	Y-coordinate in meters
<i>z</i>	Z-coordinate in meters

- A dummy quaternion (w = 1) is used for orientation
- Orientation tolerance is set to (any orientation allowed)
- Position tolerance is set to 1 cm
- Uses `set_pose_target ()` and `go (wait=True)` to execute motion

Returns

Logs success/failure to ROS log output

7.3.2 Variable Documentation

7.3.2.1 group_name

```
pathplanning_cmd.group_name = sys.argv[1]
```

7.3.2.2 x

```
pathplanning_cmd.x = float(sys.argv[2])
```

7.3.2.3 y

```
pathplanning_cmd.y = float(sys.argv[3])
```

7.3.2.4 z

```
pathplanning_cmd.z = float(sys.argv[4])
```

7.4 sero_multi_station Namespace Reference

Moves a robot arm between predefined named targets and optionally to custom poses, positions, or joint configurations.

7.4.1 Detailed Description

Moves a robot arm between predefined named targets and optionally to custom poses, positions, or joint configurations.

Moves a robot arm to a 3D position with neutral orientation using MoveIt.

This script uses MoveIt to execute a typical sequence for a multi-robot cell. It includes named targets and helper functions for absolute poses, Cartesian positions, and joint values.

@requires rospy @requires moveit_commander @requires geometry_msgs.msg @requires tf.transformations

This script is intended for basic position-only control (ignoring orientation). It sets a pose goal with w=1.0 and disables orientation constraints.

@requires rospy @requires moveit_commander @requires geometry_msgs.msg

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/pid_gains.yaml](#) File Reference
- 8.17** [src/sero_multi_station/config/trajectory_controller.yaml](#) File Reference
- 8.18** [src/sero_multi_station/launch/bringup_moveit.launch](#) File Reference
- 8.19** [src/sero_multi_station/launch/bringup_moveit_just_sim.launch](#) File Reference
- 8.20** [src/sero_multi_station/launch/control_utils.launch](#) File Reference
- 8.21** [src/sero_multi_station/launch/factory_station.launch](#) File Reference
- 8.22** [src/sero_multi_station/launch/sero_multi_station_empty_world.launch](#) File Reference
- 8.23** [src/sero_multi_station/robot_description/sero_multi_station.urdf](#) File Reference
- 8.24** [src/sero_multi_station/scripts/pathplanning.py](#) File Reference

Namespaces

- [pathplanning](#)
- [sero_multi_station](#)

Moves a robot arm between predefined named targets and optionally to custom poses, positions, or joint configurations.

Functions

- def [pathplanning.move_to_named_target](#) (group_name, target_name)
- def [pathplanning.move_to_pose](#) (group_name, pose)
- def [pathplanning.move_to_position](#) (group_name, x, y, z)
- def [pathplanning.create_pose](#) (name, x, y, z, roll_deg, pitch_deg, yaw_deg)
- def [pathplanning.move_to_joint_positions_deg](#) (group_name, joint_values_deg)

Variables

- [pathplanning.anonymous](#)

8.25 src/sero_multi_station/scripts/pathplanning_cmd.py File Reference

Namespaces

- [pathplanning_cmd](#)
- [sero_multi_station](#)

Moves a robot arm between predefined named targets and optionally to custom poses, positions, or joint configurations.

Functions

- def [pathplanning_cmd.move_to_position](#) (group_name, x, y, z)

Moves the specified MoveIt group to a 3D target position (x, y, z).

Variables

- [pathplanning_cmd.group_name](#) = sys.argv[1]
- [pathplanning_cmd.x](#) = float(sys.argv[2])
- [pathplanning_cmd.y](#) = float(sys.argv[3])
- [pathplanning_cmd.z](#) = float(sys.argv[4])

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

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

8.28 src/sero_multi_station_moveit_config/config/fake_controllers.yaml
File Reference

8.29 src/sero_multi_station_moveit_config/config/gazebo_↔
controllers.yaml File
Reference

8.30 src/sero_multi_station_moveit_config/config/joint_limits.yaml File
Reference

8.31 src/sero_multi_station_moveit_config/config/kinematics.yaml File
Reference

8.32 src/sero_multi_station_moveit_config/config/ompl_planning.yaml
File Reference

8.33 src/sero_multi_station_moveit_config/config/ros_controllers.yaml
File Reference

8.34 src/sero_multi_station_moveit_config/config/sensors_3d.yaml File
Reference

8.35 src/sero_multi_station_moveit_config/config/simple_moveit_↔
controllers.yaml File
Reference

8.36 src/sero_multi_station_moveit_config/config/stomp_planning.yaml
File Reference

8.37 src/sero_multi_station_moveit_config/launch/chomp_planning_↔
pipeline.launch.xml File
Reference

8.38 src/sero_multi_station_moveit_config/launch/default_warehouse_↔
db.launch File
Reference

8.39 src/sero_multi_station_moveit_config/launch/demo.launch File
Reference

Index

- abs_pose
 - hmi_gui, [15](#)
- anonymous
 - pathplanning, [22](#)
- base_pose
 - hmi_gui, [15](#)
- changed
 - hmi_gui, [16](#)
- cmake_minimum_required
 - CMakeLists.txt, [25](#)
- CMakeLists.txt
 - cmake_minimum_required, [25](#)
- create_pose
 - pathplanning, [21](#)
- current_group_name
 - hmi_gui, [16](#)
- current_index
 - hmi_gui, [16](#)
- current_pose
 - hmi_gui, [16](#)
- doc/gazebo_station.dox, [25](#)
- doc/hmi_interface.dox, [25](#)
- doc/ros_overview.dox, [25](#)
- eps
 - hmi_gui, [16](#)
- group
 - hmi_gui, [16](#)
- group_name
 - hmi_gui, [16](#)
 - pathplanning_cmd, [24](#)
- h
 - hmi_gui, [16](#)
- height
 - hmi_gui, [17](#)
- hmi_gui, [13](#)
 - abs_pose, [15](#)
 - base_pose, [15](#)
 - changed, [16](#)
 - current_group_name, [16](#)
 - current_index, [16](#)
 - current_pose, [16](#)
 - eps, [16](#)
 - group, [16](#)
 - group_name, [16](#)
 - h, [16](#)
 - height, [17](#)
 - image_paths, [17](#)
 - impl, [17](#)
 - load_texture_from_png, [14](#)
 - move, [17](#)
 - move_relative, [14](#)
 - move_relative_rpy, [14](#)
 - move_to_absolute_pose, [15](#)
 - move_to_home, [15](#)
 - orientation, [17](#)
 - pitch, [17](#)
 - pkg_dir, [17](#)
 - planning_groups, [18](#)
 - q, [18](#)
 - relative_x, [18](#)
 - relative_y, [18](#)
 - relative_z, [18](#)
 - roll, [18](#)
 - rot_step, [18](#)
 - rpy_move, [18](#)
 - step, [19](#)
 - step_size, [19](#)
 - success, [19](#)
 - target, [19](#)
 - tcp_links, [19](#)
 - tex_id, [19](#)
 - textures, [19](#)
 - w, [19](#)
 - wait, [20](#)
 - width, [20](#)
 - window, [20](#)
 - x, [20](#)
 - y, [20](#)
 - yaw, [20](#)
 - z, [20](#)
- image_paths
 - hmi_gui, [17](#)
- impl
 - hmi_gui, [17](#)
- load_texture_from_png
 - hmi_gui, [14](#)
- move
 - hmi_gui, [17](#)
- move_relative
 - hmi_gui, [14](#)
- move_relative_rpy
 - hmi_gui, [14](#)

- move_to_absolute_pose
 - hmi_gui, 15
- move_to_home
 - hmi_gui, 15
- move_to_joint_positions_deg
 - pathplanning, 21
- move_to_named_target
 - pathplanning, 21
- move_to_pose
 - pathplanning, 22
- move_to_position
 - pathplanning, 22
 - pathplanning_cmd, 23
- orientation
 - hmi_gui, 17
- pathplanning, 21
 - anonymous, 22
 - create_pose, 21
 - move_to_joint_positions_deg, 21
 - move_to_named_target, 21
 - move_to_pose, 22
 - move_to_position, 22
- pathplanning_cmd, 23
 - group_name, 24
 - move_to_position, 23
 - x, 24
 - y, 24
 - z, 24
- pitch
 - hmi_gui, 17
- pkg_dir
 - hmi_gui, 17
- planning_groups
 - hmi_gui, 18
- q
 - hmi_gui, 18
- README.md, 25
- relative_x
 - hmi_gui, 18
- relative_y
 - hmi_gui, 18
- relative_z
 - hmi_gui, 18
- roll
 - hmi_gui, 18
- rot_step
 - hmi_gui, 18
- rpy_move
 - hmi_gui, 18
- sero_multi_station, 24
- setup.sh, 25
- src/sero_hmi/CMakeLists.txt, 25
- src/sero_hmi/package.xml, 26
- src/sero_hmi/scripts/hmi_gui.py, 26

- src/sero_multi_station/CMakeLists.txt, 25
- src/sero_multi_station/config/joint_state_controller.yaml, 28
- src/sero_multi_station/config/pid_gains.yaml, 28
- src/sero_multi_station/config/trajectory_controller.yaml, 28
- src/sero_multi_station/launch/bringup_moveit.launch, 28
- src/sero_multi_station/launch/bringup_moveit_just_sim.launch, 28
- src/sero_multi_station/launch/control_utils.launch, 28
- src/sero_multi_station/launch/factory_station.launch, 28
- src/sero_multi_station/launch/sero_multi_station_empty_world.launch, 28
- src/sero_multi_station/package.xml, 26
- src/sero_multi_station/robot_description/sero_multi_station.urdf, 28
- src/sero_multi_station/scripts/pathplanning.py, 28
- src/sero_multi_station/scripts/pathplanning_cmd.py, 29
- src/sero_multi_station_moveit_config/CMakeLists.txt, 25
- src/sero_multi_station_moveit_config/config/cartesian_limits.yaml, 31
- src/sero_multi_station_moveit_config/config/chomp_planning.yaml, 31
- src/sero_multi_station_moveit_config/config/fake_controllers.yaml, 31
- src/sero_multi_station_moveit_config/config/gazebo_controllers.yaml, 31
- src/sero_multi_station_moveit_config/config/joint_limits.yaml, 31
- src/sero_multi_station_moveit_config/config/kinematics.yaml, 31
- src/sero_multi_station_moveit_config/config/ompl_planning.yaml, 31
- src/sero_multi_station_moveit_config/config/ros_controllers.yaml, 31
- src/sero_multi_station_moveit_config/config/sensors_3d.yaml, 31
- src/sero_multi_station_moveit_config/config/simple_moveit_controllers.yaml, 31
- src/sero_multi_station_moveit_config/config/stomp_planning.yaml, 31
- src/sero_multi_station_moveit_config/launch/chomp_planning_pipeline.launch, 31
- src/sero_multi_station_moveit_config/launch/default_warehouse_db.launch, 31
- src/sero_multi_station_moveit_config/launch/demo.launch, 31
- src/sero_multi_station_moveit_config/launch/demo_gazebo.launch, 31
- src/sero_multi_station_moveit_config/launch/fake_moveit_controller_manager.launch, 31
- src/sero_multi_station_moveit_config/launch/gazebo.launch, 31
- src/sero_multi_station_moveit_config/launch/joystick_control.launch, 31
- src/sero_multi_station_moveit_config/launch/move_group.launch, 31

[31](#) textures
src/sero_multi_station_moveit_config/launch/moveit_rviz.launch, [hmi_gui, 19](#)
[31](#)
src/sero_multi_station_moveit_config/launch/ompl- w
chomp_planning_pipeline.launch.xml, [31](#) hmi_gui, [19](#)
src/sero_multi_station_moveit_config/launch/ompl_planning_pipeline.launch.xml, wait
[31](#) hmi_gui, [20](#)
src/sero_multi_station_moveit_config/launch/pilz_industrial_motion_planner_planning_pipeline.launch.xml, width
[31](#) hmi_gui, [20](#)
src/sero_multi_station_moveit_config/launch/planning_context.launch, window
[31](#) hmi_gui, [20](#)
src/sero_multi_station_moveit_config/launch/planning_pipeline.launch.xml, x
[31](#)
src/sero_multi_station_moveit_config/launch/ros_control_moveit_controller_manager.launch.xml, hmi_gui, [20](#)
[31](#) pathplanning_cmd, [24](#)
src/sero_multi_station_moveit_config/launch/ros_controllers.launch, y
[31](#)
src/sero_multi_station_moveit_config/launch/run_benchmark_ompl.launch, hmi_gui, [20](#)
[31](#) pathplanning_cmd, [24](#)
src/sero_multi_station_moveit_config/launch/sensor_manager.launch.xml, yaw
[31](#) hmi_gui, [20](#)
src/sero_multi_station_moveit_config/launch/sero_multi_station_moveit_sensor_manager.launch.xml, z
[31](#)
src/sero_multi_station_moveit_config/launch/setup_assistant.launch, hmi_gui, [20](#)
[31](#) pathplanning_cmd, [24](#)
src/sero_multi_station_moveit_config/launch/simple_moveit_controller_manager.launch.xml,
[31](#)
src/sero_multi_station_moveit_config/launch/stomp_planning_pipeline.launch.xml,
[31](#)
src/sero_multi_station_moveit_config/launch/trajectory_execution.launch.xml,
[31](#)
src/sero_multi_station_moveit_config/launch/warehouse.launch,
[31](#)
src/sero_multi_station_moveit_config/launch/warehouse_settings.launch.xml,
[31](#)
src/sero_multi_station_moveit_config/package.xml, [26](#)
src/station_peripherals/CMakeLists.txt, [26](#)
src/station_peripherals/launch/station_peripherals.launch,
[31](#)
src/station_peripherals/package.xml, [26](#)
src/station_peripherals/urdf/conveyor_belt_1.urdf, [31](#)
src/station_peripherals/urdf/conveyor_belt_2.urdf, [31](#)
src/station_peripherals/urdf/sero_1_socket.urdf, [31](#)
src/station_peripherals/urdf/sero_2_socket.urdf, [31](#)
src/station_peripherals/urdf/sero_3_socket.urdf, [31](#)
src/station_peripherals/urdf/workobject.urdf, [31](#)
step
hmi_gui, [19](#)
step_size
hmi_gui, [19](#)
success
hmi_gui, [19](#)
target
hmi_gui, [19](#)
tcp_links
hmi_gui, [19](#)
tex_id
hmi_gui, [19](#)