Technical Report

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Planning trajectories for the Esautomatix workcell

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Abstract

The iri_twin_staubli_plan_execute_trajectory package allows to plan trajectories in the esautomatix cell for both, simulation in Gazebo and execution in the real robots.
The esautomatix_write_trajectory package allows you to record the trajectories of the two Staubli arms at the same time or for a single arm, to be able to reproduce them afterwards.

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1 How to use the iri_twin_staubli_plan_execute_trajectory package

This node can be used to simulate in Gazebo or execute in the real workcell the different robots which conform the cell. The source code can be downloaded from:

`devel.iri.upc.edu/labrobotica/ros/iri-ros-pkg_hydro/metapackages/esautomatix_robot/`

The different motions can be planned using MoveIt or can be read from a txt file recorded with the package esautomatix_write_trajectory. Some of the next instructions are optional, depending on the type of execution.

1. Start a robot instance. There are three different options:
   (a) To use the *simulation* through the MoveIt interface launch:
      - **roslaunch esautomatix_moveit_config demo.launch**
   (b) To use the simulation through the Gazebo launch:
      - **roslaunch esautomatix_moveit_config moveit_planning_execution.launch**
      - **roslaunch esautomatix_gazebo esautomatix.launch**
   (c) To use the real robot you have to launch the following commands using a multiple machines configuration[1] following the apropriate Technical Report[2]:
      - **roslaunch esautomatix_bringup esautomatix_bringup.launch**
      - **roslaunch iri_xy_controller iri_xy_controller.launch (In the BeagleBoard)**
      - **roslaunch iri_meg50ec_gripper meg50ec_gripper.launch**
      - **roslaunch esautomatix_moveit_config moveit_planning_execution.launch**
2. Start the execution node.
   - **roslaunch iri_twin_staubli_plan_execute_trajectory iri_twin_staubli_plan_execute_trajectory.launch**
3. Publish the cell environment Additionally, the walls of the cell can be published using the iri_staubli_scene node.

[1] `http://wiki.iri.upc.edu/index.php/Multiple\_machines`

[2] S. Hernández and F. Herrero. Multi-master ROS systems. Technical Report IRI-TR-15-01, Institut de Robòtica i Informàtica Industrial, CSIC-UPC, 2015.

1.1 Action

The communication with this node is performed though the next defined action:

```
\# Define the goal
string plan_type  #plan_cart, plan_joints, plan_l_cart,
                  plan_l_joints, plan_r_cart, plan_r_joints,
                  plan_l_straight_cart, plan_r_straight_cart,
                  move_xy, open_l_gripper, open_r_gripper,
                  close_l_gripper, move_l_gripper, close_r_gripper,
                  move_r_gripper, both_traj_read, left_traj_read,
                  right_traj_read.
int8 type_execut #MoveIt(0), Gazebo(1), Realrobot(2)
bool question
float64 velocity           \#between 0 to 1
string file_name
float64[] joints_l
float64[] joints_r
geometry_msgs/Pose pose_l
geometry_msgs/Pose pose_r
---

\# Define the result
bool planned
bool executed
---
```

1.2 Action features

The Action Goal allows to choose if you want to be asked before executing or planning a trajectory (**question** field), and to select the real or simulated robot(**type_execut** field). The percent of the velocity trajectory for the Staubli robots can be also indicated (**velocity** field), and through the field **plan_type**, the type of motion to use can be selected:

- **Plan_cart, plan_l_cart, plan_r_cart, plan_l_straight, plan_r_straight**: to describe the target positions write them in the pose_l and pose_r to move both arms. If only one arm is required, then use the corresponding variable.
- **Plan_joints, plan_l_joints, plan_r_joints**: to describe the target joints write them in the joints_l and joints_r to move both arms. If only one arm is required, then use the corresponding variable.
- **Move_xy**: in this case the target position in the reference cell must be written in the variable joints_l.
- **Open_l_gripper, close_l_gripper, open_r_gripper, close_r_gripper**: no requires further information.
- **Move_l_gripper, move_r_gripper**: The target position is written in the joints_l or joints_l.
- **Both_traj_read, left_traj_read, right_traj_read**: in this case you must indicate in the file_name the path of the txt file.

This action server return two booleans, one to indicate if the planning was satisfactory (planned), and the other to indicate if the execution was satisfactory.

To better understand how to use this action examples are provided in the **esautomatix_motions** package. With this package you can use all the features of the previous action through the terminal. The question and the type_execut can be modified in the file

`twin_staubli_plan_execute_trajectory_alg_node.cpp`

After recompile, the node is launched with the command:

- **roslaunch esautomatix_motions esautomatix_motions.launch**

Follow the instructions to choose the plan_type and the you'll be asked about the information which you have to provide.

2 How to use the esautomatix_write_trajectcory package

This package can be used to save trajectories in a text file. It can be used afterwards to provide a trajectory to the iri_twin_staubli_plan_execute_trajectory package.

Trajectories are obtained with the topics /left_staubli_controller/JointPathCommand for the left arm and /right_staubli_controller/JointPathCommand for the right arm.

To launch the node use the following command

- **roslaunch esautomatix_write_trajectory esautomatix_write_trajectory.launch**

It works as follows: first you have to choose which kind of record you want to do, left arm record, right arm record or both arm record. After you have to write the path where you want to save the file. Now you only have to move the robot and the file will be created. The robot can be moved using the MoveIt interface.

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