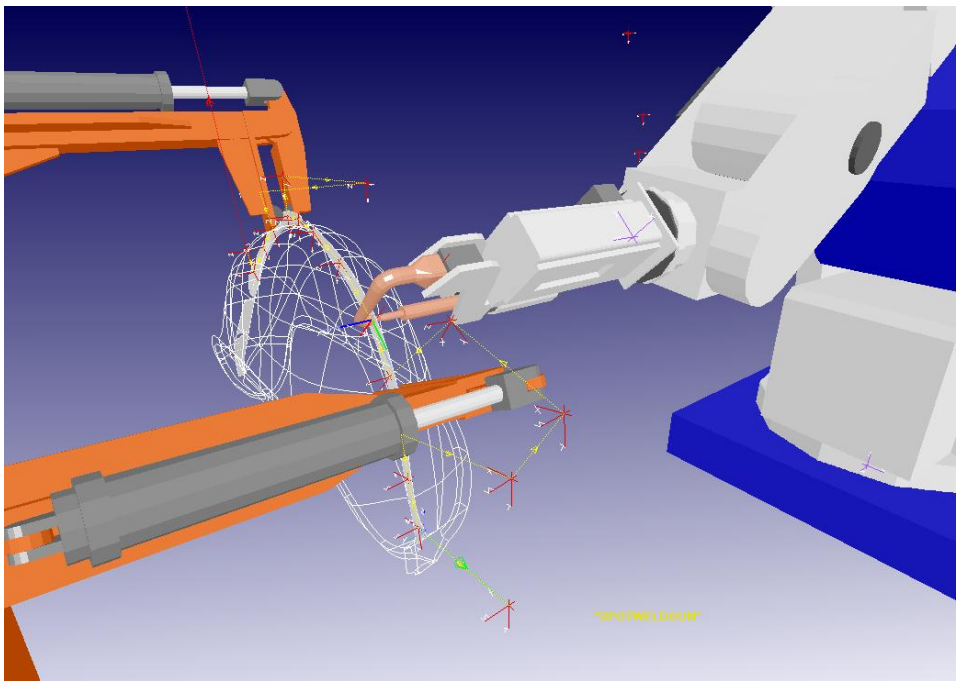
The new Version

EASY-ROB™ V4.007



SEPTEMBER 2005

Version 1.1

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EASY-ROB™

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EASY-ROB™ V4.007

The new version

The current version EASY- ROB™ V4.007 contains a lot of new features which will be explained, using the example workcell „Spotweld_demo.cel“. The most important development is the multiple kinematics, which have a significant impact on the EASY-ROB ™ operating concept. Furthermore additional operating elements, ERPL/ERCL commands and API C-functions, which should facilitate the planning, layouting and simulation of robot work cells, have been added. But this release is also a milestone on the long road of success. The new functions are helpful and bring an advantage, but they also come with new requirements.

At this point we would like to thank our customers and users, who keep up the development in the right lane, giving us good advices and proposals.

Thank you

Stefan Anton

EASY-ROB
3D Robot Simulation Tool

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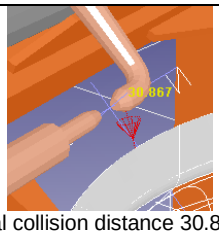
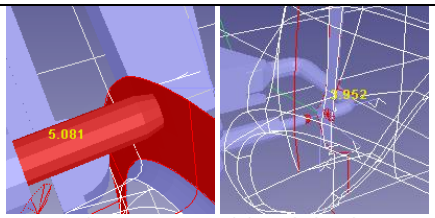
Work cell „Spotweld_demo.cel“

The Zip-archive „Projects-v4007.zip” contains several examples. Please unpack the Zip-file with its sub-folders to an appropriate directory on your hard disk.

Start EASY-ROB™ and load the work cell „Spotweld_demo.cel“. As soon as the work cell is loaded completely, click „Run”  , to start the linked program „spotweld_demo.prg“ and the Mimic-file „spotweld.mmc“. You can see how the robot is grabbing a spot welding gun and starting to weld some sports on the work piece. While the simulation is running some prospects respectively view-files „spotweld_n.vie” are loaded, so that the scenario can be observed in an optimal way. Furthermore the collision check has been activated. If there is a collision between the geometries of the robot and the kinematics, the collided parts will be colored red and the not-collided will be colored blue. This helps you to localize the locations of the collision.



minimal collision distance 30.867 mm

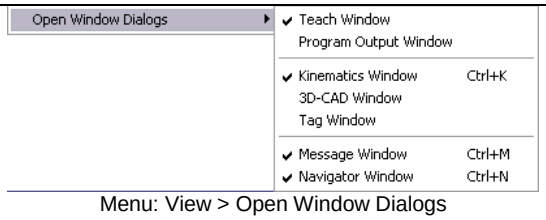


ERC RED_BLUE_COLLISION ON
ERC STOP_COLLISION ON

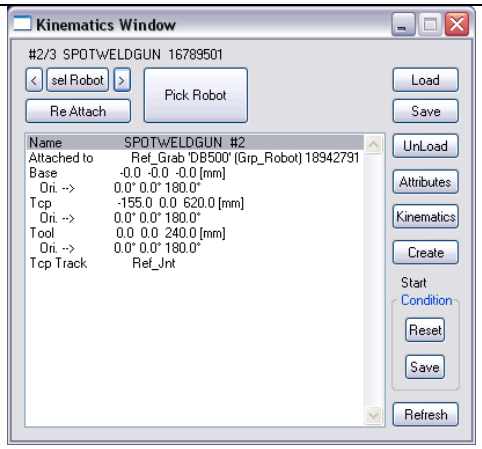
The Spotweld-cell consists of three kinematics. The first kinematic is the 6-axis articulated robot, named DB500. The second kinematic is the spot weld gun “SPOTWELDGUN”, the third the fixture with the work piece “WELD FIXTURE”. The Kinematics Window gives you a good overview of all loaded kinematics.

You can open the „Kinematics Window” by using the Short-Key „Ctrl+K“, or double click on the 

Icons or using the Menu “View > Open Window Dialogs“. You can also keep the dialogue open, while the simulation is running.



Menu: View > Open Window Dialogs



Kinematics Window dialogue

You can find more information in the pdf-document „Operation-References_Multiple-Kin.pdf“.

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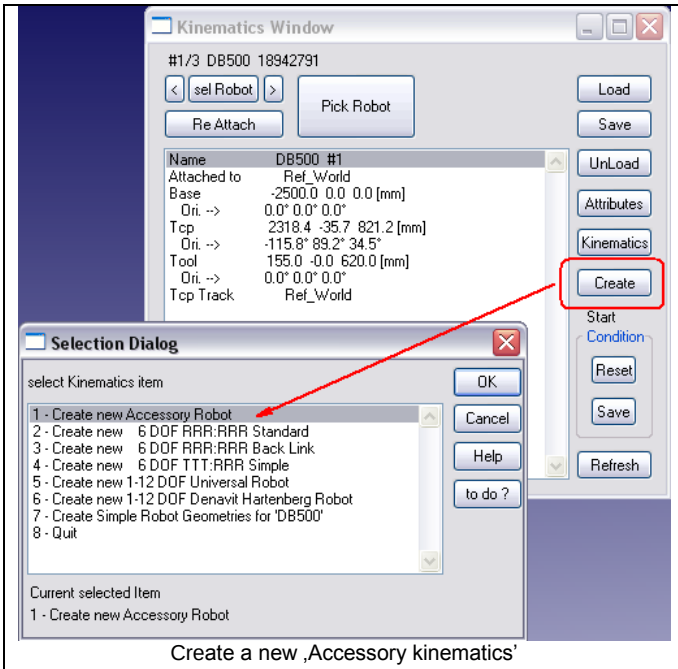
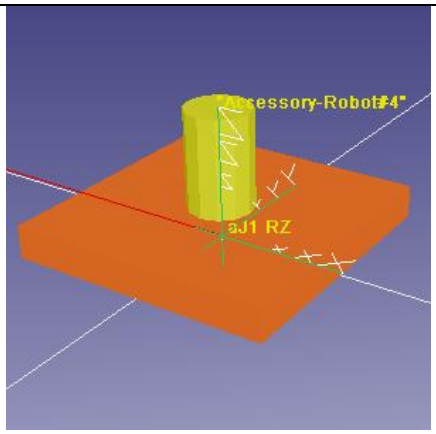
Unlike the operating philosophy of previous EASY-ROB™ versions, our work cell has an empty Body- respectively Environment-Group. Normally we would have added the two geometries of the "WELD_FIXTURE" kinematics to the ‚Body-Group' and positioned them individually afterwards. EASY-ROB™ V4.007 is now:

- One kinematic will be created for each geometry-group. The created „accessory"-kinematics has one rotational axe in z-direction per default. Many geometries can be assigned to this kinematics. By moving the kinematics respectively the robot-base all geometries which belong to the group will be moved, too.

A new kinematic can be created directly out of the Kinematics Window. By clicking on the ‚Create-button' and choosing ‚Accessory Kinematics', a new kinematics with the name ‚Accessory-Robot#4' and one Rz-axe will be created. Furthermore simplified robot geometries (one orange-colored box for the base and one yellow-colored cylinder for the first axe) can be created optionally for each axis. These geometries can be replaced in the ‚3D-CAD Window' by importing suitable CAD geometries.



Create a new ‚Accessory kinematics'
as „Universal Robot" with one DoF Rot(z,q1)



Accessory kinematics with simplified default geometry.

By clicking on the button  all names, coordinate systems, axe numbers and joint directions, as well as the reference compounds of all kinematics will be displayed.

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Concatenation of kinematics

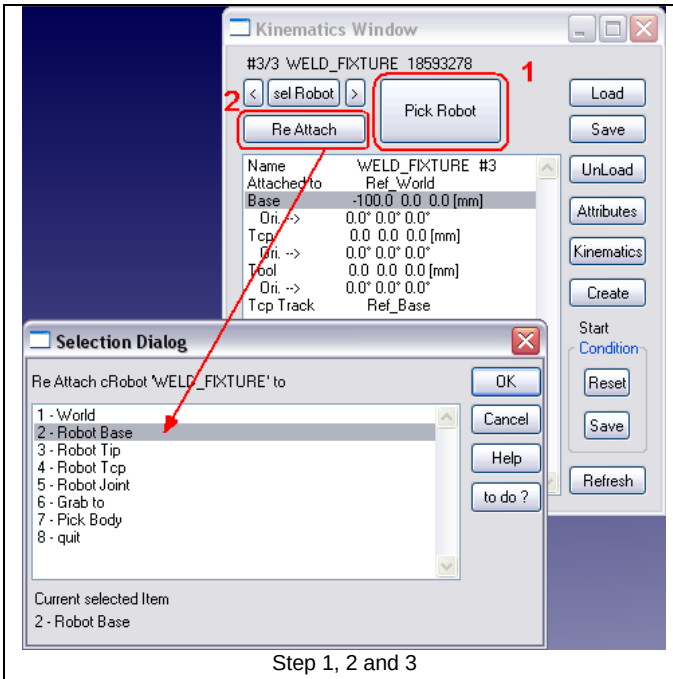
Kinematics can be concatenated. Let's have a look at the robot DB500: The second line in the list of the Kinematic Window says „Attached to Ref_World". So the DB500 is positioned with respect to the world. The position of the DB500 is described by the ‚Base' = (-2500 , 0 , 0), with respect to the world coordinate system.

Hint: By clicking twice on the third line, the robot base position can be changed immediately, using the 'Frame Dialog'.

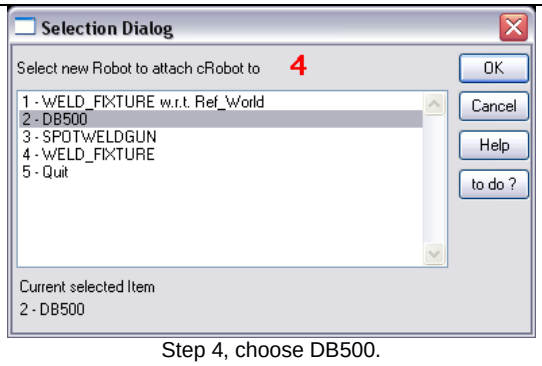
The same applies to 'WELD_FIXTURE', which is described with respect to the world. The 'WELD_FIXTURE' has to be attached to the base of the DB500, if we want it to be moved together with the DB500.

To attach 'WELD_FIXTURE' to the base of the DB500, the following steps have to be made

1. Choose the actual kinematics 'WELD_FIXTURE', by clicking on the button ‚Pick Robot' in the Kinematics Window. Choose the 'WELD_FIXTURE' with the LMB.
2. Click the button ‚Re-Attach' in the ‚Kinematics Window'.
3. Choose ‚2 - Robot Base'
   => „Re Attach cRobot ‚WELD_FIXTURE' to Robot Base
4. Choose DB500
   = > The 'WELD_FIXTURE' moves now together with the base of the DB500
5. For the „Yes"-case and if you want the position of 'WELD_FIXTURE' in space to remain unchanged, the coordinates have to be transformed accordingly.
6.



Step 1, 2 and 3



Step 4, choose DB500.

Step 5, Transformation of the base, so that the resulting position of ‚WELD_FIXTURE' remains unchanged. The new calculated base-position is (2400, 0, 0)

Important: The number of kinematics in a work cell is not limited. You can load and attach as many kinematics as you wish, with the exception that no closed chains will be formed.

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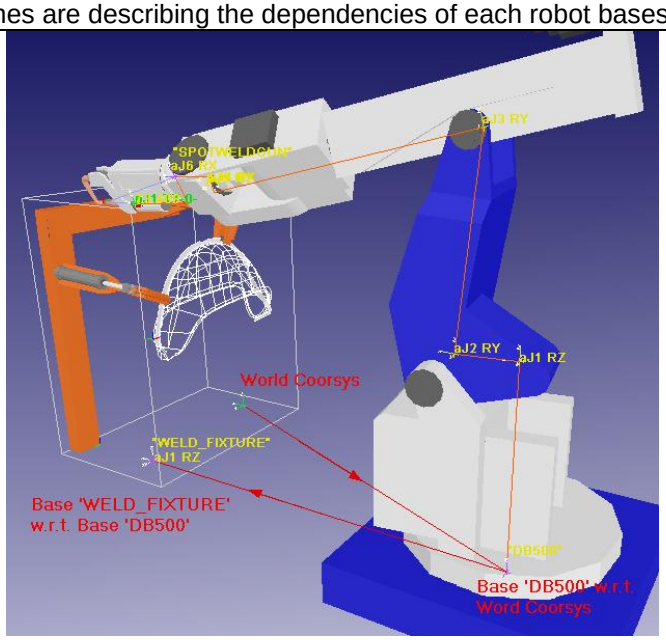
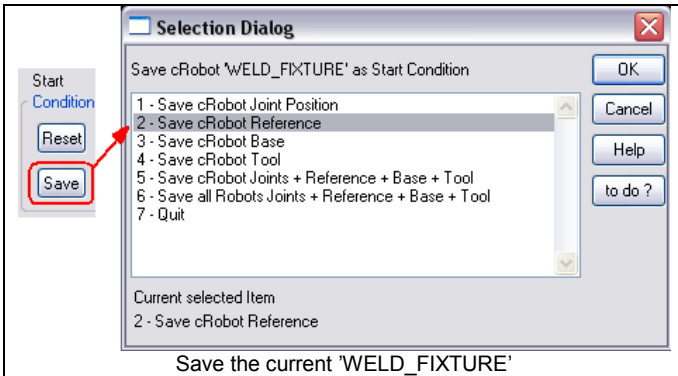
Click the icon  to display the concatenation of the kinematics. The red reference-connections respectively connection-lines are describing the dependencies of each robot bases.



'WELD_FIXTURE' w.r.t. 'DB500'

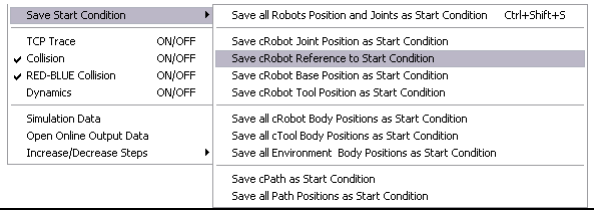
However, concatenations are temporary and remain only as long as they will be saved. The reason is as follows: During a simulation run the kinematics are grabbed (example Spotweldgun) and their positions and joint-positions changed. If the simulation run is aborted with STOP and run again, all kinematics and geometries jump back into the so called **'Start Condition'**. That means that the concatenation between the 'WELD_FIXTURE' and the ‚DB500' will be dissolved. If you want to keep the concatenation you have to save it as 'Start Condition' first.



Save the current 'WELD_FIXTURE' reference as Start Condition

Hint: Make sure to save the current concatenation of the kinematics, before you start the Simulation by clicking on RUN, otherwise all temporary concatenations will be dissolved.

Menu: Simulation >



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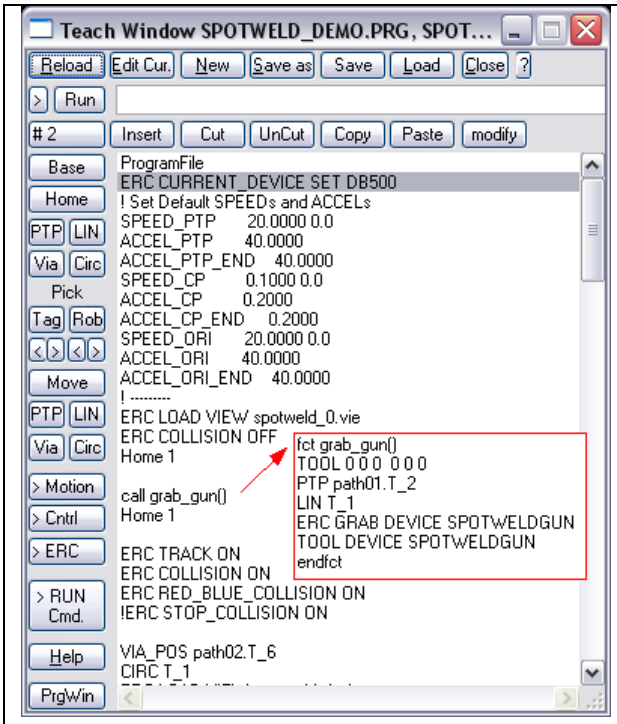
The 'Spotweld_Demo' program for the simulation run

The program, Spotweld_Demo.prg ' and the associated Mimic-file ‚Spotweld.mmc' – especially the used Multi-KIN commands - will be explained below.

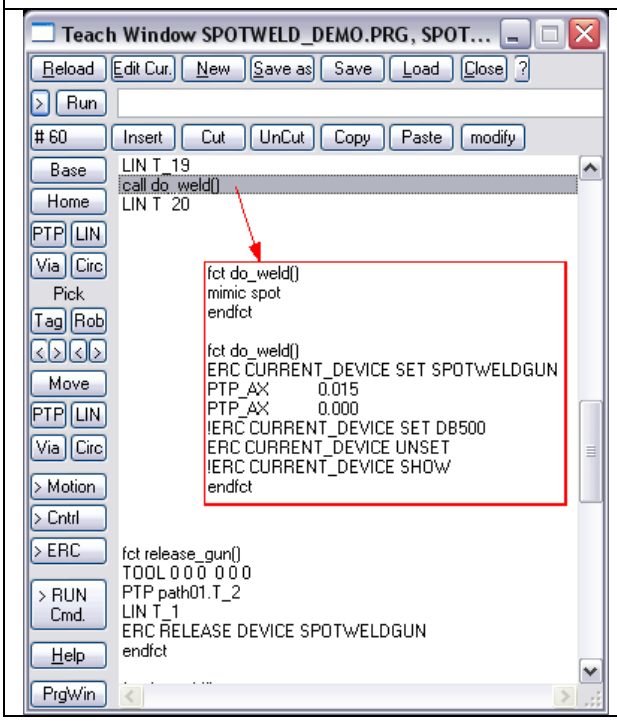


Using the ERCL-command "**ERC CURRENT DEVICE SET DB500**" the DB500-kinematic will be set active. All following ERPL- and ERCL-commands refer to the current kinematic.

In order to obtain reproducible results, velocities and accelerations have been programmed.

The function **grab_gun()** has the task to move the DB500 to the position T_2 of the path ‚path01', to grab the kinematic ‚SpotweldGun' and to take over the TCP of the Spotweldgun for the DB500.

Tool 0 0 0 0 0 0 sets the TCP of the DB500 to the Tip
PTP path01.T_2 moves the DB500 to T_2 of the path ‚path01'. With the syntax 'path01.T_2' the tag point T_2 is uniquely determined, because also the path 'path02' consists a Tag-Point 'T_2'
LIN T_1 moves the DB500 to T_1 of the current path path01
ERC GRAB DEVICE SPOTWELDGUN attaches the kinematic ‚SPOTWELDGUN' to the tip of the DB500.
TOOL DEVICE SPOTWELDGUN sets the TCP of the DB500 to the TCP of the SPOTWELDGUN
ERC COLLISION ON activates collision check
ERC RED_BLUE_COLLISION ON activates red/blue-collision



The function **do_weld()** has the task to open and to close the SPOTWELDGUN
This kinematic will be moved axe-specific and has no inverse kinematic solution. The following ERC-commands can also be realized in the Mimic-file with the keyword SPOT. The command **mimic spot** can also be run as single set command.

ERC CURRENT DEVICE SET SPOTWELDGUN activates the Spotweldgun
PTP_AX 0.015 moves the first axe of the S-Gun about 15mm, afterwards again to 0mm.

ERC CURRENT DEVICE UNSET Re-activates the previously active kinematic, here the DB500.
Important: do not active the DB500 with ERC CURRENT DEVICE SET DB500 otherwise it is not possible to use the function do_weld() for a second robot like DB500#2. In this case the command should be ERC CURRENT DEVICE SET DB500#2!

The function **release_gun()** has the task to move the DB500 to the grab-point T_2 of the path ‚path01' and to release the kinematic ‚SpotweldGun'. The TCP will be set to the Tip of the DB500 again.

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New ERPL- and ERCL commands

See also "EASY-ROB-CMD.txt"

ERPL-, ERCL-Syntax	Examples
CALC 'math expression'	calc a= 0.5 calc b= a * sin (45*RAD) LIN_REL 0 0 0.1*a 0 0 0
CALC SHOW_VARS	Shows all variables in the Message Window. Variables with the Prefix $ are system variables
CALC SHOW_USER_VARS	Shows all User-variables (without Prefix $) in the Message Window.
TOOL DEVICE 'robotname'	Sets the TCP of the current kinematic to the position of the TCP of the kinematic which is determined with the name ‚robotname'.
ERC VIEW_CHOREOGRAPHY ON,OFF	Activates / deactivates View Choreograpghy ERC LOAD View commands will be suppressed.
ERC KUD row col value	Sets the value of the kinematic userdata via Row- and column specification ERC KUD 1 1 1 ERC KUD 12 12 144
ERC KUD Name value	ERC KUD KUD_1_1 1 ERC KUD KUD_12_12 144
ERC SET_PARAMETER $NAME_1 'name'	ERC SET_PARAMETER $NAME_1 T_1 ERC SET_PARAMETER $NAME_100 MYROBOT ERC CURRENT DEVICE SET $NAME_100 LIN $NAME_1
ERC SET_PARAMETER $NAME_RESET	Deletes the content of all $NAME-variables
ERC SET_PARAMETER $NAME_INFO	Shows the content of all $NAME-variables in the Message Window.
ERC CURRENT_DEVICE SET 'robotname'	Activates the kinematic 'robotname' All following ERPL- and ERCL-commands refer to the active kinematic.
ERC CURRENT_DEVICE UNSET	Sets the previously active kinematic to inactive
ERC CURRENT_DEVICE CLEAR	Deletes the kinematic-stack
ERC CURRENT_DEVICE SHOW	Shows all kinematics in the kinematic-stack
ERC GRAB DEVICE 'robotname'	The current kinematic grabs the kinematic with the name 'robotname'
ERC RELEASE DEVICE 'robotname'	The current kinematic separates from the kinematic with the name 'robotname'

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New ERPL- and ERCL commands

ERPL-, ERCL-Syntax	Examples
ERC COLLISION BODY [ROBOT,TOOL] bodyname OFF, ON=CONVEX, CONCAVE, CONVEX, BBOX	Sets the attribute for the collision check of the geometry with the name ‚bodyname' of the groups BODY, ROBOT or TOOL to OFF, ON=CONVEX, CONCAVE or BBOX. ERC Collision Robot Part_1 Concave
ERC COLLISION BODY_GRP [ROBOT_GRP,TOOL_GRP] OFF, ON=CONVEX, CONCAVE, CONVEX, BBOX	Sets the attribute for the collision check for all geometries of the group BODY_GRP, ROBT_GRP or TOOL_GRP to OFF, ON=CONVEX, CONCAVE or BBOX
ERC COLLISION QUEUE BODY_ROBOT ON,OFF	Activates / deactivates the collision check between the groups BODY vs. ROBOT
ERC COLLISION QUEUE BODY_TOOL ON,OFF	Activates / deactivates the collision check between the groups BODY vs. Tool
ERC COLLISION QUEUE ROBOT_TOOL ON,OFF	Activates / deactivates the collision check between the groups Robot vs. Tool
ERC COLLISION QUEUE GRABBODY_ROBOT ON,OFF	Activates / deactivates the collision check between the groups grabbed BODY vs. ROBOT
ERC COLLISION QUEUE GRABBODY_BODY ON,OFF	Activates / deactivates the collision check between the groups grabbed BODY vs. Ungrabbed BODY
ERC COLLISION QUEUE ROBOT_ROBOT ON,OFF	Activates / deactivates die the collision check between the geometries within one ROBOT_GRP
ERC COLLISION QUEUE BODY_BODY ON,OFF	Activates / deactivates the collision check between the geometries within one BODY_GRP
ERC COLLISION QUEUE ALL ON,OFF	Activates / deactivates the collision check between all groups
ERC COLLISION DISTANCE x [mm]	Collision tolerance value, collision will be shown if the minimal collision distance of two geometries falls below the value X.
ERC DISPLAY_ROBOT_COORSYS ON,OFF	Activates / deactivates the visualization of the coordinate systems of all robot kinematics
ERC DISPLAY_ROBOT_NAME ON,OFF	Activates / deactivates the visualization of the names of all robot kinematics
ERC RED_BLUE_COLLISION ON, OFF	Activates / deactivates Red/Blue collision. Geometries which collide will be colored red, not-colliding geometries will be colored blue.
ERC LOAD TAGS ‘tag file name'	Loads a Tag-file '*.tag'
ERC LOAD MIMIC ‘mimic file name'	Loads mimic file '*.mmc'
ERC LOAD CAMERA ‘camera file name'	Loads camera file '*.cam'
ERC PAUSE	Stops the simulation

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