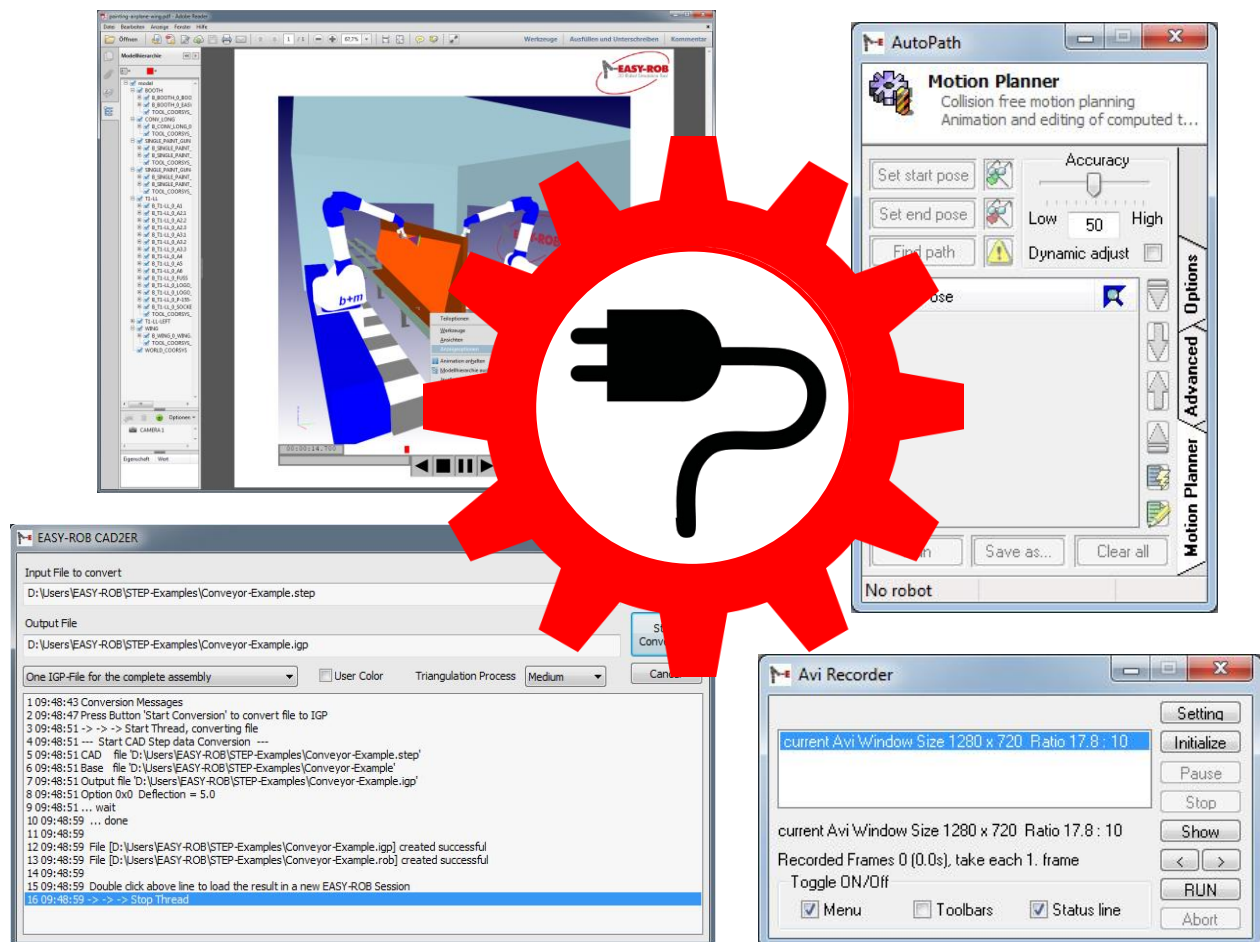


Operation References

Special Functions & Plugins

EASY-ROB™ V6.6



June 2015

Version 2.8

EASY-ROB™

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EASY-ROB™

Operation References

PlugIn Dlls

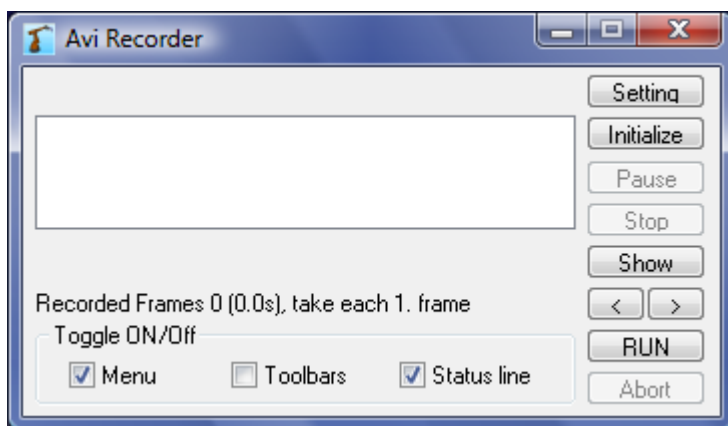
AVI - Recorder


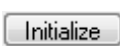

In the current version of EASY-ROB™ you can directly create AVI video files. There's no external software needed for video capturing.

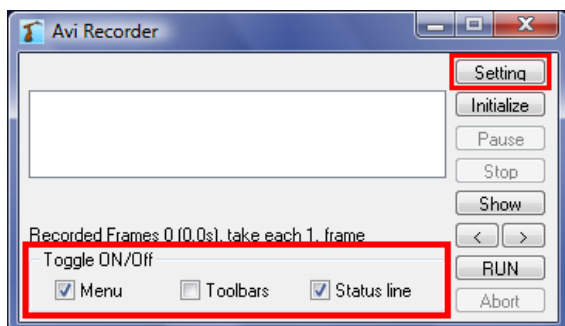
1. Load the cell (*.cel)
2. Open the panel either by using the menu
View | EASY-ROB PlugIn Dlls | AVI Recorder or use the button:



Alternative: Push the "F6" Button

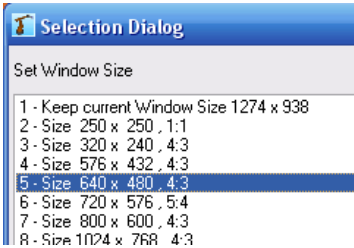
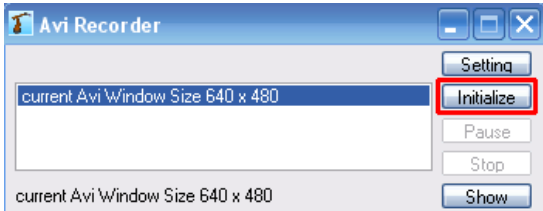
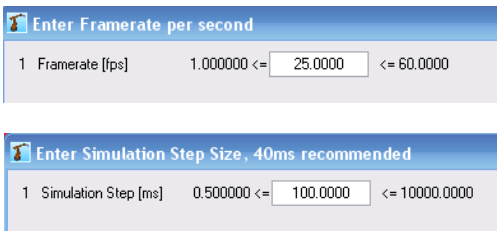
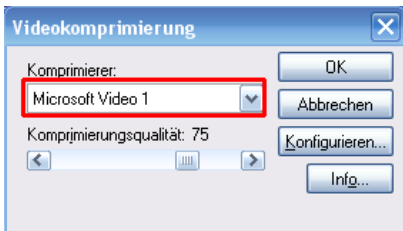
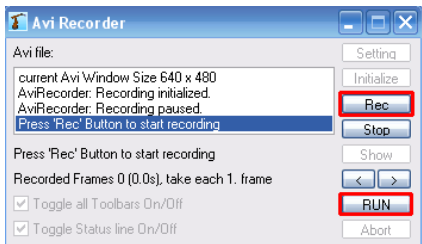
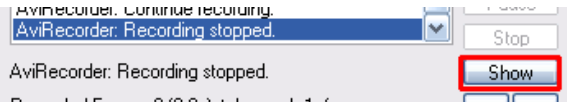


	Select window-size		Show Recording
	Select a path where to save the file		Select: Number of frames
	Pause Recording		Start Simulation
	Stop Recording		Abort Simulation



First you have to select if you want to capture the recording with or without the toolbar and status line.

AVI Recorder

	<p>With a click on “Setting” you can select a window size</p>
	<p>With a click on „Initialize“ you can set the name of the file and a place where to save it</p>
	<p>After that you can set the Framerate (fps) and the Simulation-Stepsize (ms)</p>
	<p>Selecting the compressing factor is the last step before you can start a recording.</p>
	<p>With a click on „Rec“ you can start the recording</p> <p>A click on “RUN” starts the simulation.</p>
	<p>After the recording you can show the recorded AVI by using the „Show“ button</p>

EASY-ROB™

Operation References

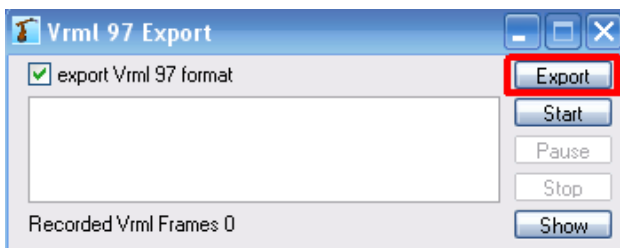
PlugIn Dlls

VRML Export

If you want to exchange the workcell (static) or the result of the simulation (with animation) you can use the VRML 97 Export to store the whole workcell including the animations sequence into a file with extension (*.vrl).

1. Load the workcell „three_robots.cel“
2. Open the panel by menu:
View | EASY-ROB PlugIn Dlls | VRML 97 Export
Alternative: Push the “F7”-Button

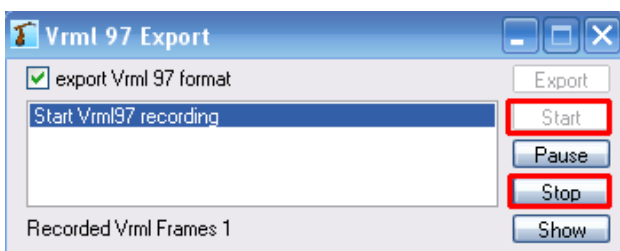
Export static:



To export a static workcell click on „Export“ and save the VRML-file.

To see the workcell in the explorer just click „Show“.

Export dynamic:



To export a workcell including the animation click on „Start“ to record and start the simulation. At the end of the simulation Stop the recording with „Stop“ and save the VRML-file.

To see the animation in the explorer just click „Show“

Remark: Prerequisite for an animation is a loaded and running program.

EASY-ROB™

Operation References

PlugIn Dlls

Path planning with AutoPath™

To engineer a workpiece into the fixture or to move around an interfering geometry is a time-consuming task.

The EASY-ROB™ option **AutoPath™** will support the user to plan and create collision free paths.

The example below will show the capability and the functionality of AutoPath™.

1.
Load the workcell

AutoPath_Example_01.cel

with the button *Load from Library*
from the directory:

../EASY-ROB / ApplicationLib /



Start Device Manager
Shortcut: „Ctrl+Shift+O“

Annotation:

The example demonstrates a typical initial situation and the result of a collision free path planning done by AutoPath™.

The workpiece has to go through the frame and has to be placed on the other side of the frame.

The first cycle shows the shortest way from start to the target – of course including collision.

The path in the second cycle was planed by AutoPath™ and is collision free. While planning a path, AutoPath™ is taken the axis limits of the robot into consideration.

An additional geometry on the way through the frame requires a further optimization of the path.

In the last cycle the workpiece is moving along the optimized path.

2.
Start the simulation with the button
Run Program



Shortcut: „Ctrl+R“

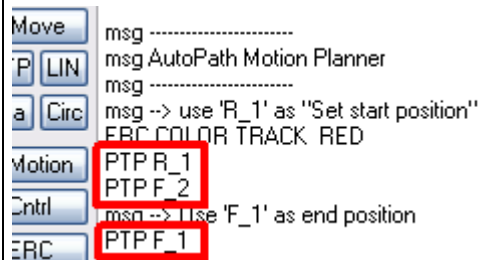
Introduction of the AutoPath™ example

Commentary of the single steps of the program:

3.
Open the *Teach Window* by mouse click on the button *Open Program Teach Window* to see the current program



4.
After the declaration of the variables and the settings for the collision detection the robot will move by PTP-commands (line 26) from the start position to the target position.



5.
The second cycle was planned by AutoPath™. The collision free positions are placed for a better overview into a sub function (fct ComputedMotion(), line 59).

The base for path planning is a collision free start and target position (2 tagpoints).
The calculated collision free positions in between will be stored as axis values (including start and target position)

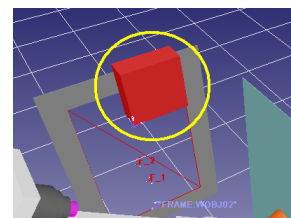
The determined positions for the move forward can be used in reverse order for the way back.

```
call ComputedMotion()

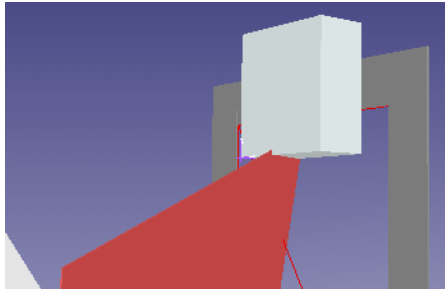
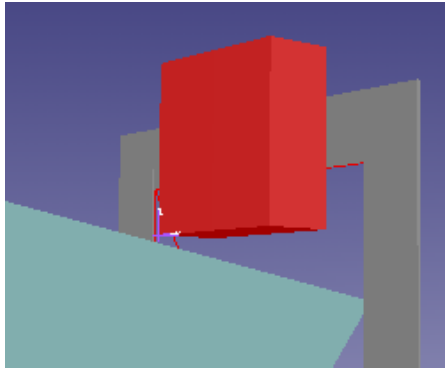
fct ComputedMotion()
CONFIG      5
PTP_AX 0.001987 14.918705 24.145096 -0.723742 -65.057760 -1.044701
PTP_AX 11.358115 6.773610 34.196621 -61.874079 -53.128671 -23.215272
PTP_AX 37.312795 10.036447 18.948508 -56.884667 -38.187299 -7.011792
PTP_AX 46.571021 16.165010 7.437025 -41.405253 -54.501604 26.808908
PTP_AX 39.803718 40.294771 12.634212 -43.407540 -90.668994 27.589344
WAIT      2.0000
! go back
PTP_AX 46.571021 16.165010 7.437025 -41.405253 -54.501604 26.808908
PTP_AX 37.312795 10.036447 18.948508 -56.884667 -38.187299 -7.011792
PTP_AX 11.358115 6.773610 34.196621 -61.874079 -53.128671 -23.215272
PTP_AX 0.001987 14.918705 24.145096 -0.723742 -65.057760 -1.044701
endfct
```

6.
After the second cycle geometry will be set to visible.
(line 48)

```
!-----
! Plan another Path with Disturbance
!-----
ERC CURRENT_DEVICE SET DISTURBANCE
ERC DISPLAY_CROBOT ON
ERC CURRENT_DEVICE UNSET
```



Introduction of the AutoPath™ example

<p>7. The path is not collision free anymore and requires a further optimization.</p>	<p>call <code>ComputedMotion()</code></p> 
<p>8. By using AutoPath™ the path was optimized and stored in the function „call <code>ComputedMotion_with_Disturbance()</code>“.</p>	<p>call <code>ComputedMotion_with_Disturbance()</code></p> 

EASY-ROB™

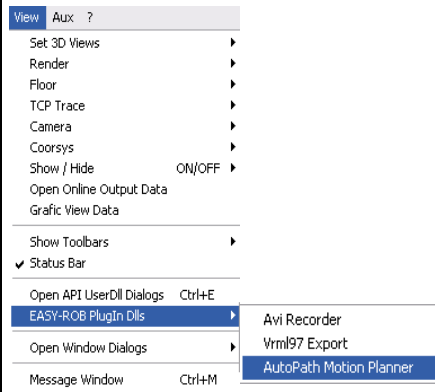
PlugIn Dlls

Operation References

Path planning with AutoPath™ – Dialog and Operation

1. Start the AutoPath™ dialog from the menu

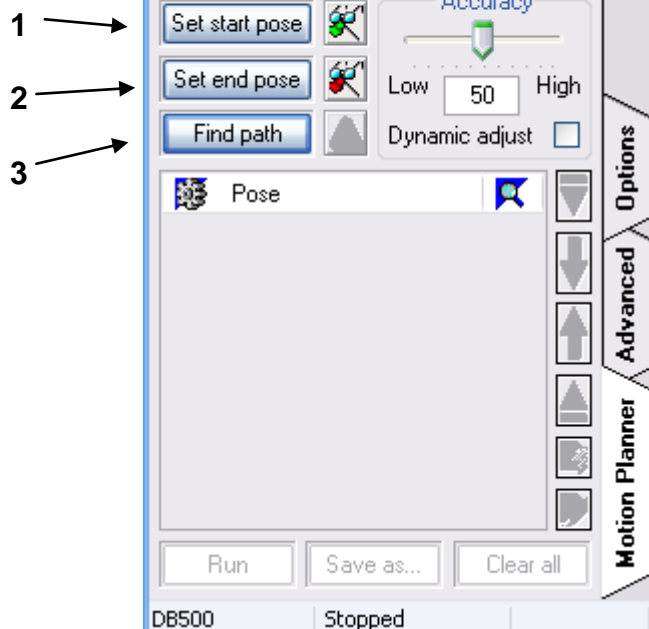
View | EASY-ROB PlugIn Dlls | AutoPath Motion Planner



2. The dialog AutoPath™ and the most important elements:

1. Set start pose
(to set the collision free start position, without exceeding the axis limits of the robot)
2. Set end pose
(to set the collision free end position, without exceeding the axis limits of the robot)
3. Find path
(search a collision free path from start to the target position)

The calculation can take several minutes – depending on the complexity of the situation and the computer performance.



AutoPath™ Dialog and Operation

<p>3. Open the <i>Tag Window</i> by double click on the button <i>Sel Tag</i></p> <p>(workcell <i>AutoPath_Example_01.cel</i>)</p>	
<p>4. Select with „<i>sel Pth</i>“ the path „<i>Rob</i>“ and move the robot to tagpoint R_1 (double click the tagpoint in the list of the TagWindow)</p>	
<p>5. Click the button „Set start pose“ in the motion planner to set the tagpoint R_1 as start position.</p>	
<p>6. Select with „<i>sel Pth</i>“ the path „<i>Frame</i>“ and move the robot to tagpoint F_1 (double click the tagpoint in the list of the TagWindow)</p>	
<p>7. Click the button „Set end pose“ in the motion planner to set the tagpoint F_1 as end position.</p>	

AutoPath™ Dialog and Operation

8.
Leave all settings to default and click „Find path“ in the AutoPath™ dialog to calculate a collision free path.

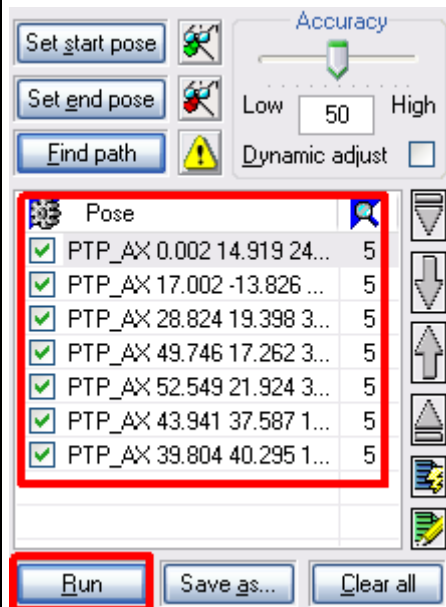


Important Note:

The process to calculate a collision free path can take up to several minutes – please don't lose the patience and don't start any other EASY-ROB™ functions while the calculation.

9.
After the search the collision free path will be displayed as single positions.

Move along the positions by clicking on “Run”.



EASY-ROB™

Operation References

CAD Import

Import VRML

All common 3D-CAD systems like Catia, ProEngineer, Solid Works, Solid Edge, etc are able to export VRML 1.0 and VRML 2.0 .

EASY-ROB™ can import VRML files and save them as IGP-Files (*.igp). The Import does not include kinematics or animations in the VRML-file.

Additionally to the *.igp-file the importer will create automatically a *.rob-file.

Even when the files from different systems are all VRML-files, with regard to the inner structure (number of objects and number of polygons) they are all different.

Solid Edge, UGS e.g. is using „Shapes“ to set colors and objects.

EASY-ROB™ is taking this into consideration while import by using a presetting and the functionality to „merge“ the polygons.

The „merger“ will reduce the number of objects and will increase the number of polygons per object.

And even when the file that the merger is creating will be bigger as the „not-merged“ file, you will have a better performance .

In the „VRML-Examples“-folder you will find examples from different systems with some remarks about the presetting.

TIP: Always use the „**Merger**“, so you will have a better performance while rendering.

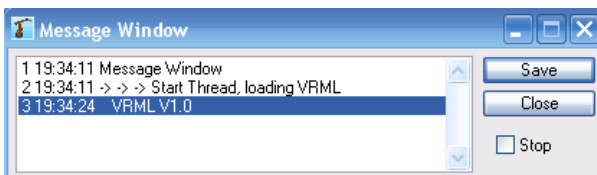
VRML files are ASCII-files. You can open and read them in every editor.

Most times you will find additional information in the header of the file.

TIP: Before the import always save your work and start a new session of EASY-ROB.

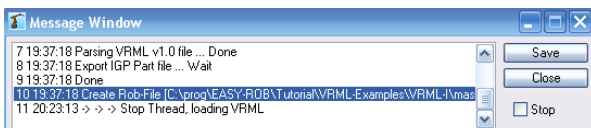
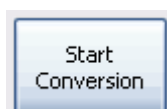
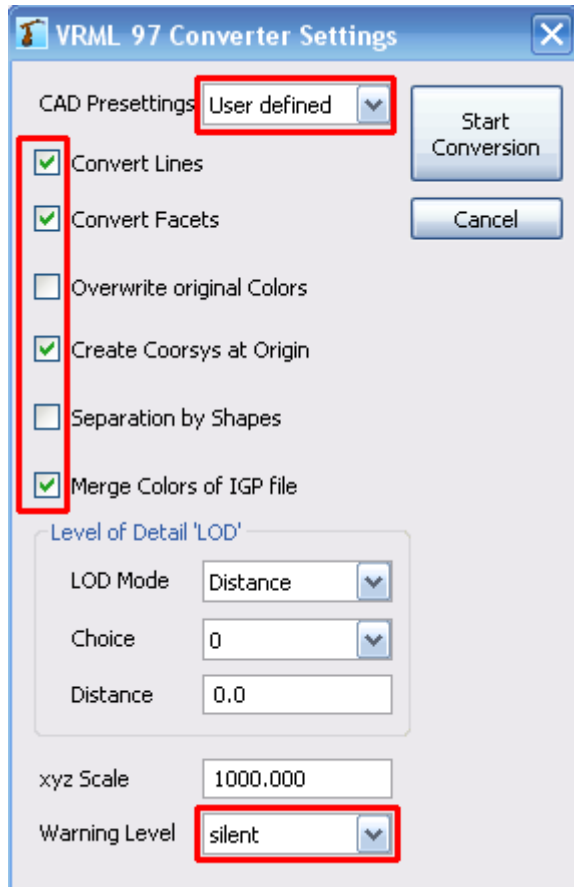
To load a VRML file you can either

1. select the file by menu File | Load | Import / Convert | Convert VRML1.0 /2.0 into CAD Preview
or
2. use „Drag'n Drop“ from Explorer



Beside the Message Window you will get the dialog for the Converter Settings

CAD Import - VRML



By the CAD Presetting you can configure the exporting system.

This is important because depending on the export system EASY-ROB has to use different options for the import

TIP:

Always use the presetting.
Changing the presetting can cause bad system performance.

With the Warning level you decide how much information you will get while the import.

Silent = Standard messages
Warning = only warnings
Verbose = detailed

With Start Conversion
you can start the converter

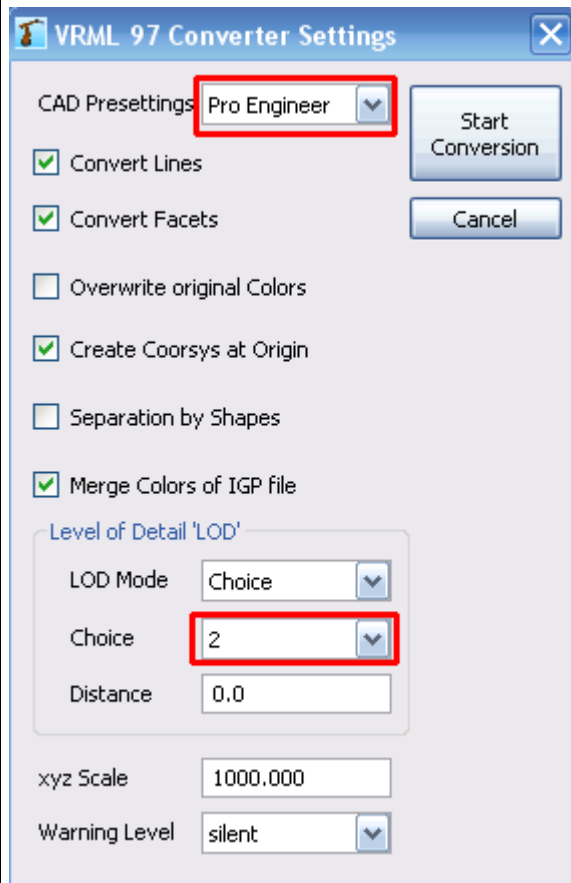
In the Message Window you can follow all messages and by using the „Save“-button you can store the protocol of the import

TIP:

Double click onto a line with bracket will open the file in the editor
Double click onto any other line will delete the whole Message Windows

CAD Import- VRML

EXTRA for the import from Pro Engineer



While reading parts from Pro Engineer you are able to reduce the data by using the LOD (Level of Detail)

By using this option you can reduce the data-volume and increase the system performance.

EASY-ROB™

Operation References

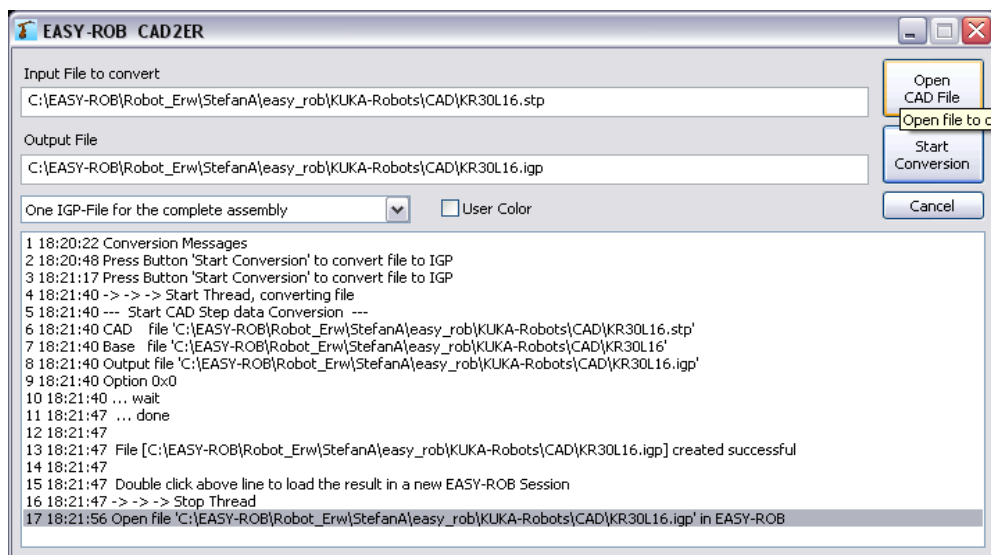
CAD Import

CAD2ER – Converting STEP- and VRML II 97-files to IGP

By using EASY-ROB™ - CAD2ER STEP- and VRML II,97 files can be converted to IGP. You can find the application as an independent program in the subfolder ./cad2er/ of the EASY-ROB™ - Application.

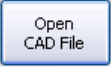


Opened Rob- und IGP- files will be loaded in a new EASY-ROB Session.

Start CAD2ER with the shortcut „Ctrl+Shift+C“ or by Menu: Load > Start CAD2ER Converter



CAD2ER was developed in collaboration with *machineering* GmbH & Co. KG (www.machineering.de).

Handling

- Select the file you want to convert by clicking on .
- Change the name of the file into „Output File“
- Place a checkmark on „User Color“ to configure the colour.
- Click on  to begin the conversion of the file.
- Double-click on the generated file-name in „[]“ brackets to open the file in a new EASY-ROB-session.
- Quit CAD2ER by clicking on .

TIP: Native CAD-files, like CATIA V4/V5 or Pro/Engineer can be converted to STEP by using the software „3D-Tool“.

EASY-ROB™

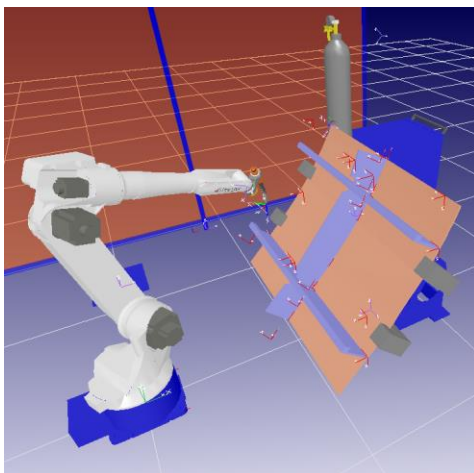
Operation References

CAD Export

CAD-file Export

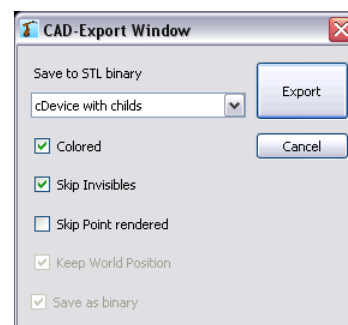
Single robots or devices or even the complete workcells can be exported as binary STL-files. STL binary is a neutral format and can be imported in all common CAD-Systems. Furthermore the results of the planer can be analyzed by the user.

Optional: the exported STL-file can also include colours, though it is not supported by every CAD-system.



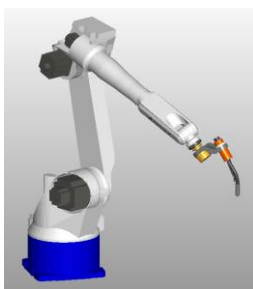
Workcell: arcweld_L_01.cel

To export a robot select a robot by click on Menu: File > Save > Export > STL binary, to open the **CAD Export Window**

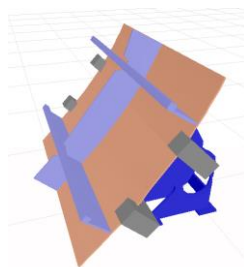


Selecting „cDevice with childs“ exports the robot with the Welding-Torch as coloured STL-file e.g.. „cDeviceChilds_stl“.

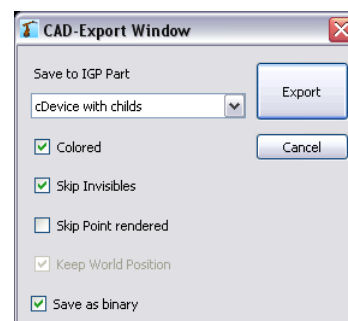
To export the rotary tabel „POSITIONER_01“ with the component „WORKPIECE_02 „ to a **IGP binary-file**, the rotary table has to be selected first.



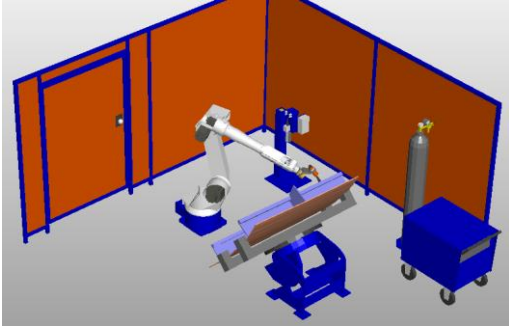
Robot as STL binary file



Rotary table als IGP binary file



CAD-file Export



Workcell as VRML II,97 file

IGP binary-file decreases file-size to nearly 50%.
Import will happen 20% more faster. All
geometries will be saved in world-coordinates.

EASY-ROB™ Project Manager

Operation References

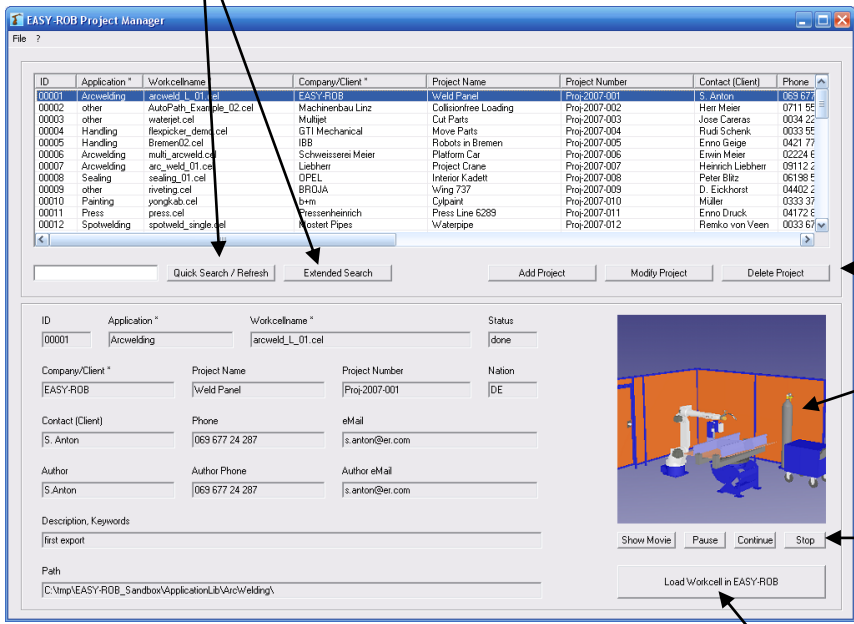
Administrate Projects

The Project Manager provides different functionalities to administrate EASY-ROB™ workcells and project related information. The search functions are supporting the user to find the desired data straight away. The project data can be stored either by using the input mask in the Project Manager or by the Visual File Interface out of EASY-ROB™ (see chapter „Visual File Interface“)

Further on the Project Manager is able to run and show videos of the workcells and is able to load the workcell straight into the EASY-ROB™.

Start the Project Manager by double click onto the executable „/EASY-ROB/easyrob-project-manager.exe“ or from EASY-ROB™ by shortcut „Ctrl+Shift+P“. Or use the menu :File Menu: Load -> Start Project Manager.

search function



project overview

project modification


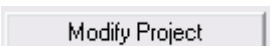
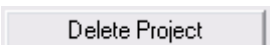

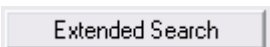
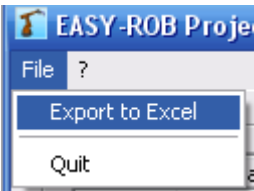
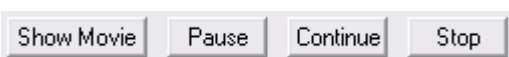

screenshot / video screen

video controls

detailed information of project

start EASY-ROB™ and load workcell

Project Manager

	Add a new projects
	Modify an existing projects
	Delete a projects
	<p>Quick Search</p> <p>Options for Quick Search:</p> <ul style="list-style-type: none"> - Enter a complete word - Enter a part of a word - Enter numbers <p>Tip: Using an empty field and „Refresh“ will show all items of the database.</p>
	Extended Search with filter
	Export all projects into an EXCEL file
	<p>Controls for the video</p> <p>(if the buttons are disabled there is no video)</p>
	<p>Start EASY-ROB™ and load the selected workcell</p> <p>(if the button is disabled there is now workcell)</p>

EASY-ROB™

History Diagram

Operation References

Visual analyses of the simulation

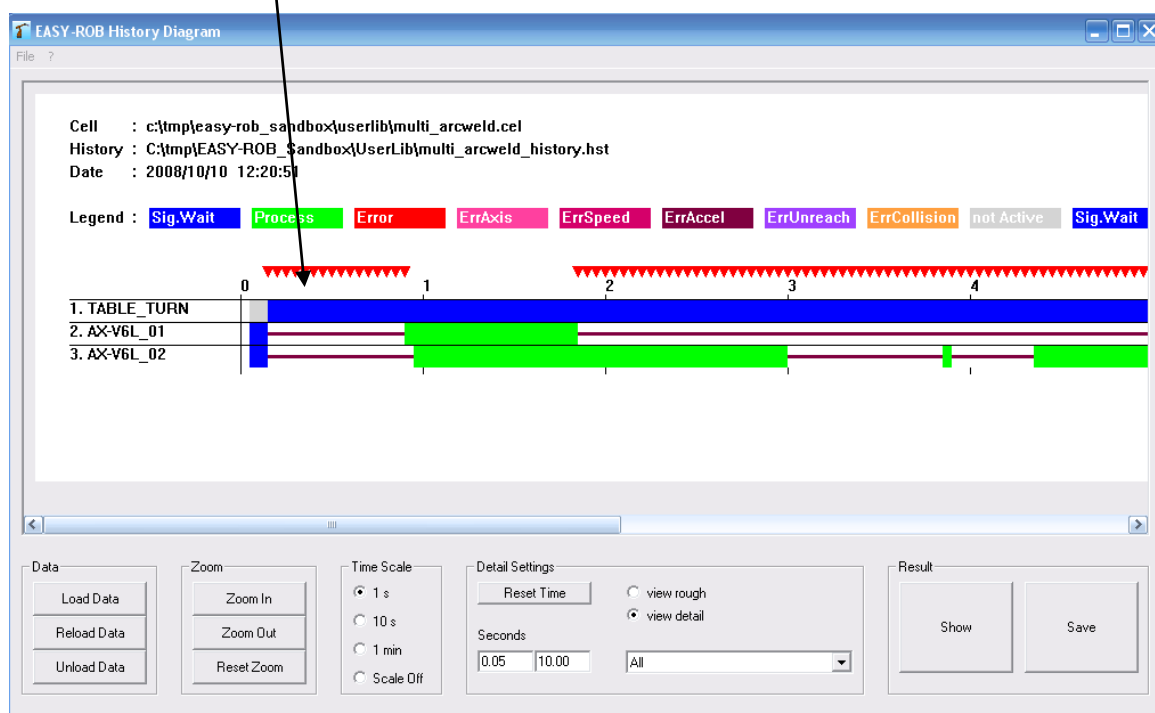
The functionality „History Diagram“ enables the user to analyze the simulation visual by a graphic.

History Diagram can record the state of every device into the workcell. The state like e.g. „waiting for signal“ or an „axis limit exceeding“ will be stored while every simulation step and be displayed and analyzed in a diagram.

Because all possible states will be shown in different colors, an occurring error can be identified immediately.


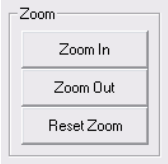


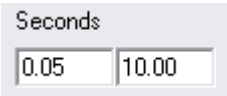
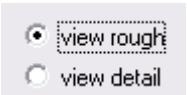


Start the History Diagram by double click onto the executable „/EASY-ROB/easyrob-history-diagram.exe“ or from EASY-ROB™ by shortcut „Ctrl+Shift+H“. To start from the menu use “File Menu: Load -> Start History Diagram.”

Graphic of the simulation



Data handling Zoom function Time scale Detail settings Show, Save data

History Diagram

	<p>Load, reload and unload history file</p>
	<p>Zoom in and out the view and reset to start conditions</p> <p>(zoom is only related to the length of the diagram, not to height)</p>
	<p>Show time scale</p> <ul style="list-style-type: none"> - every second - 10 seconds - every minute - switch scale off
	<p>Reset time to start conditions</p>
	<p>Start and end time of the displayed area</p>
	<p>Rough display :all errors in one color detailed display: every error in its own color</p>
	<p>Selection of the displayed Device (all or one Device)</p>
	<p>Show: Show the diagram (with the selected settings)</p> <p>Save: Save the diagram as JPG-picture in the same directory of the history file</p>

EASY-ROB™

ERC Command Searcher

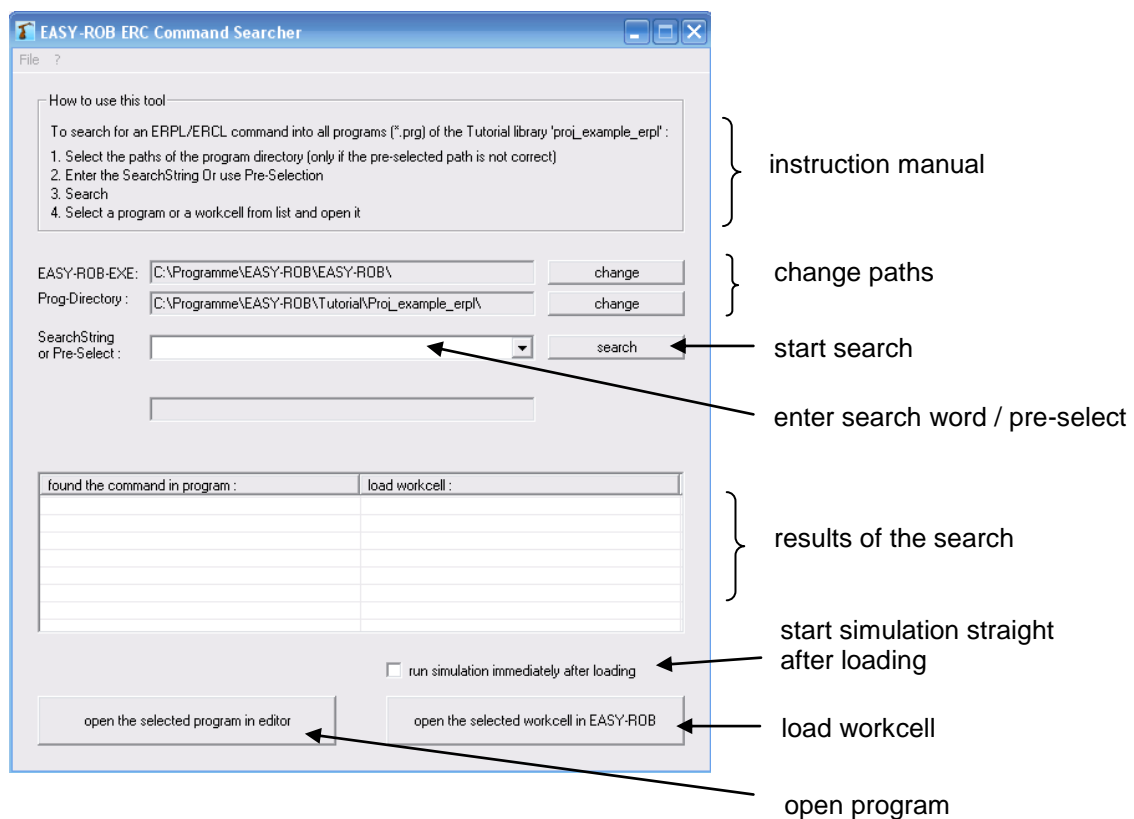
Operation References

Search ERC Commands

The example library contains for each ERPL-/ERCL- command a workcell with program.
The ERC Command Searcher will support the user to search for a specific ERC commands in the example library "Proj_example_erpl", which is normally installed in the directory:
".\EASY-ROB\Tutorial\Proj_example_erpl"

The library contains many short example programs with different ERC commands to give an impression how the commands are working

Start the ERC Command Searcher by double click onto the executable „/EASY-ROB/ easyrob-erc-command-searcher.exe“ or from EASY-ROB™ by shortcut „Ctrl+Shift+S“. From the menu use „File Menu: Load -> Start ERC Searcher“.

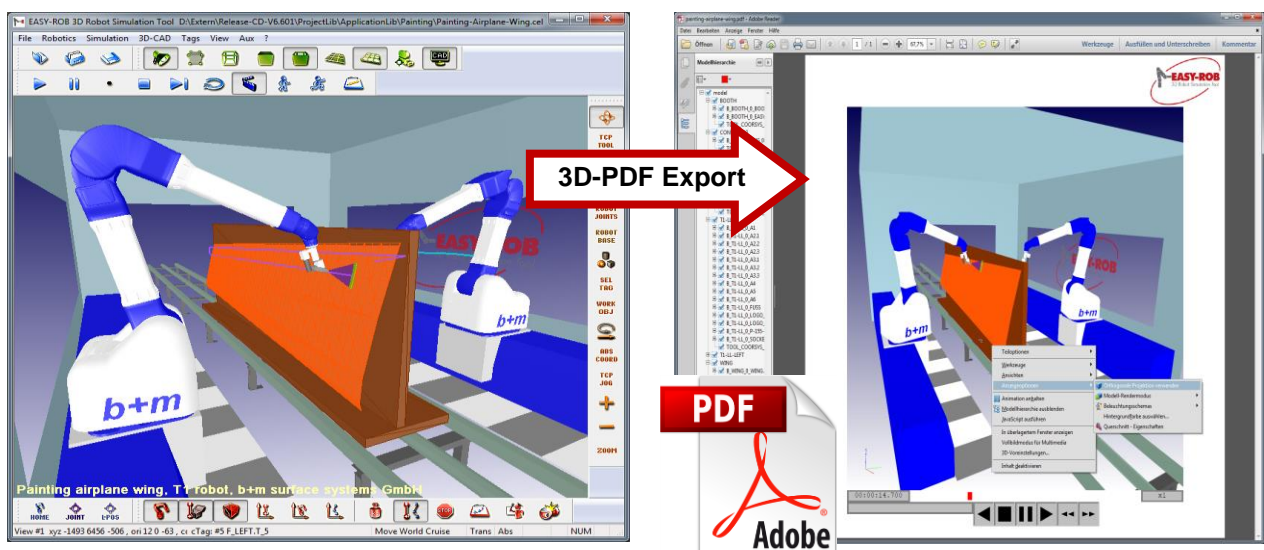


EASY-ROB™ 3D-PDF-Export

Operation References

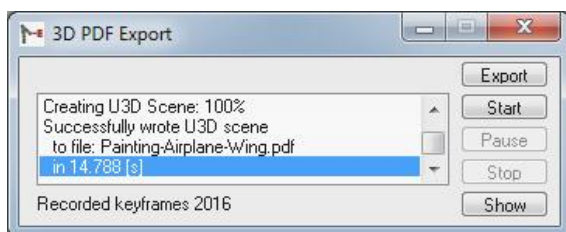
Saving simulation process in 3D-PDF-document

With the new EASY-ROB™ 3D-PDF-Export option the entire simulation process of a work cell can be saved as a 3D-PDF-document. Afterwards it can be opened, using the free Adobe® Reader XI and the whole simulation can be started.



To ensure a proper operation, we recommend using at least version XI (11.0.10) of Adobe® Reader.

The 3D-PDF-Export can be found under **View > EASY-ROB PlugIn DLLs > 3D-PDF Export**.



3D-PDF Export dialogue

- Open the 3D-PDF Export dialogue
- Click on Start to begin recording.
- Start the simulation. The simulation run will be recorded. The number of recorded frames will be displayed.
- Click on Stop to finish the recording. You will be asked to enter the destination directory and the name of the PDF document.
- The 3D-PDF-document will be created.

Within the PDF document, you can rotate and zoom the recorded scene

3D-PDF-Export

Use the navigation bar to start, pause or stop the recorded simulation process. Fast forward and rewind (x1/64 – x64x speed) are also possible. The displayed time shows you the real process time.



The 3D-PDF-Export functionality can alternatively be controlled via ERCL commands. The user then has the following ERCL commands:

`ERC _3D_PDF_EXPORT SCREENSHOT [filename]`

`ERC _3D_PDF_EXPORT ON / OFF [filename]`

`ERC _3D_PDF_EXPORT SET_FILE filename`

`ERC _3D_PDF_EXPORT SET_LABEL labelname`

`ERC _3D_PDF_EXPORT SET_PASSWORD passwordname`

`ERC _3D_PDF_EXPORT PAUSE`

`ERC _3D_PDF_EXPORT DEACTIVATE`

A detailed description of the commands can be found in the chapter “New ERCL-commands” or in the corresponding document for the ERPL- / ERCL- Program language „**EASY-ROB-ERPL_ENG.pdf**“.

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Operation References

Space Mouse

Space Mouse Connection

Navigation through 3D-Scene with a 3D-Mouse (Space Mouse) from 3DConnexion:
The 3-dimensional navigation through the robot-complex is very intuitive and accurate



Picture: 3DConnexion

Assignment of keys in your Space Explorer.

- 1 Toggles -> PanZoom
 -> Rotate
 -> Pan+Rotate
- 2 Toggles -> Cruise World
 -> Jog cTcp
 -> Jog cRobot Joints

Shift as Keyboard
Esc as Keyboard
Ctrl as Keyboard
Alt as Keyboard



- Reduces Sensitivity
- + Increases Sensitivity
- T** Top View
- L** Left View
- 2D** ohne Funktion
- R** Right View
- F** Front View

Panel Open Menu
Fit Zoom World, cRobot, cTag, ..

TIP: Further settings can be made in the Environment-file „easy-rob.env“.

! Activates/Deactivates Space Mouse Menu
S3DM_MENU 1
! Scales Space Mouse sensitivity
S3DM_SPEED 1.000000
! Scales Space Mouse threshold
S3DM_THRESHOLD 1.000000

EASY-ROB™

Operation References

Appendix

Inverse Kinematics ID's

The Inverse Kinematics ID defines the inverse kinematics and forward solution for each robot. EASY-ROB provides you with a couple of solutions for common robots like 3- or 5-axis, portalrobots, scaras, etc.

For every Kin-ID exists a Sub-ID.

You can edit the KIN-IDs and Sub-IDs in over Robotics Menu:

cRobot Kinematics -> Kinematics Data -> Inverse Kinematics ID -> Special Inverse Kinematics

Kin-ID	Name	Sub ID	Kin_Type	Kommentar
0				no inverse Kinematics available
1	DLL #1			User-definied Kinematics in „er_kin.dll“ #1
2	DLL #2			User-definied Kinematics in „er_kin.dll“ #2
3	DLL #3			User-definied Kinematics in „er_kin.dll“ #3
4	DLL #4			User-definied Kinematics in „er_kin.dll“ #4
5	DLL #5			User-definied Kinematics in „er_kin.dll“ #5
6	DLL #6			User-definied Kinematics in „er_kin.dll“ #6
7	DLL #7			User-definied Kinematics in „er_kin.dll“ #7
8	DLL #8			User-definied Kinematics in „er_kin.dll“ #8
9	DLL #9			User-definied Kinematics in „er_kin.dll“ #9
10	DLL #10			User-definied Kinematics in „er_kin.dll“ #10
11	DLL #11			User-definied Kinematics in „er_kin.dll“ #11
12	DLL #12			User-definied Kinematics in „er_kin.dll“ #12
13-99	User Inverse Kinematics			User-definied Kinematics in „er_kin.dll“ #13-99
100	NumSol	0	beliebig	Numerical Solution Kinematic >= 6 axis Further parameteres: Tolerances, Joint Weight, Mask Vecto
100	NumSol	1	beliebig	Numerical Solution Kinematic with less than 6 axis (in compliance with Approach-axis)
110	Knickarm		RzRyy:Rxyx , RzRyy:Rzyz	and Tracking-Axis „Standard RRR:RRR on Y-Track“
111	Knickarm		RzRyy:Rxyx , RzRyy:Rzyz	as 110, with „Backlink“ / „A2A3 linking“ „Back Link RRR:RRR on Y-Track“
116	Knickarm			as 110, solution w.r.t Robot Base
117	Knickarm			as 111, solution w.r.t Robot Base
122	Güdel	0, 10, 11, 12, 13		RoboFlex (Jet Roboter) xyz- Gantry xyz:Rz Gantry xz or yz Gantry xyz:Rz, yxz:Rz Gantry

Inverse Kinematics ID

Kin-ID	Name	Sub ID	Kin_Type	Kommentar
120	b+m			T1 Paintingrobot
123	Denso	0, 1		Standard RRR:RRR on Y-Track Scara 4 axis RzRzTzRz
124	Mitsubishi	0, 1		Standard RRR:RRR on Y-Track Scara 4 axis RzRzTzRz
125	Eisenmann	0,1,2, 10		vrbh6,vrbc6,vrbl5, E-Shuttle
126	Adept	0, 1	0	Standard RRR:RRR on Y-Track Scara 4 axis RzRzTzRz
127	Jet Robot		TyRyy:Rxyx, TyRyy:Rzyz	
128	Jet Robot			as 127, with „Backlink“ / „A2A3 linking“
129	Palletizer	0 1	RzRyyRz	without Backlink with Backlink
130	SCARA	0	RzRzTzRz	
133	Gantry 2 Achsen	13,23	Txz,Tyz, Tzx, Tzy, Txy, Tyx	2 Axis Portal
	Gantry 3 Achsen	123,0	Txyz,Tyxz,Tz xy,Tzyx,Txzy, Tyzx	3 Axis Portal
	Gantry 1 Achse	1,2,3	Tx, Ty, Tz	1 Axis Portal, Conveyor
134	Gantry 2+1 Achsen	13, 23	Txz,Tyz, Tzx, Tzy, Txy, Tyx, Rz	2 Axis Portal + Rz Rotary-Axis
	Gantry 3+1 Achsen	123, 0	Txyz,Tyxz,Tz xy,Tzyx,Txzy, Tyzx, Rz	3 Axis Portal + Rz Rotary-Axis
135	Gantry, 3+2 Achsen		Txyz,Tyxz,Tz xy,Tzyx,Txzy, Tyzx, CA=Rzx	5-Axis Portal with C- und A-axis
136	Gantry 6 Achsen		Txyz,Tyxz,Tz xy,Tzyx,Txzy, Tyzx, Rzxx,Rzyz	6-Axis Portal with Rzxx oder Rzyz Joint
114	Abb			Optional
118	Motoman			Optional
115	Staubli			Optional
112	Kuka			Optional
113	Fanuc			Optional
132	Tricept			Optional
137	PKM			Optional, Delta-Kinematics, FlexPicker

EASY-ROB™

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EASY-ROB Customer area

Online available: Program Updates and Robot libraries

Web: www.easy-rob.com/en/special/customer-area

Access data:

User:	customer
Password:	*****

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Notes