

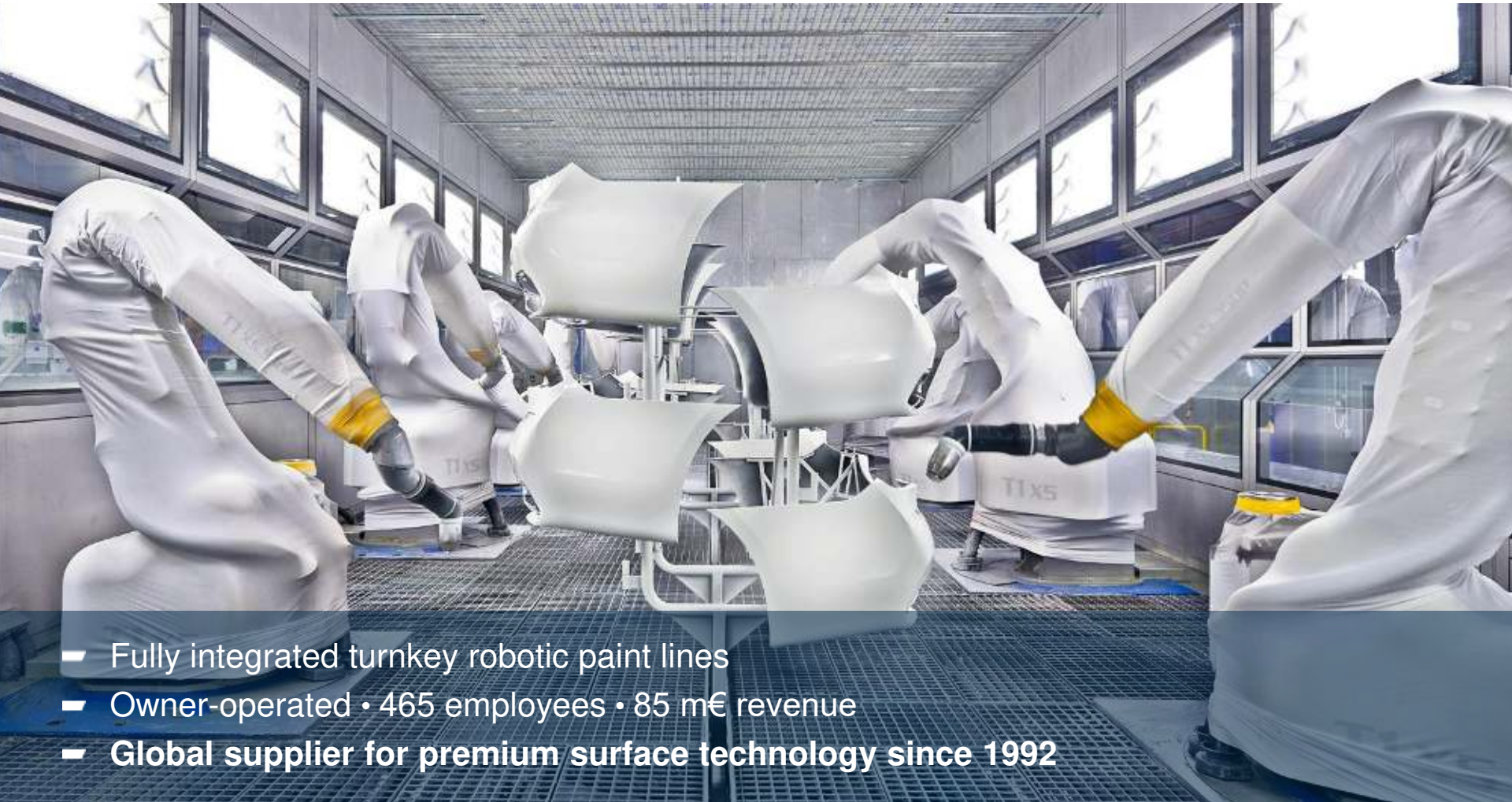
Emulate3D as High-Level Robot Programming Software **bmPaintSim**

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Agenda

1. Introduction b+m
2. Use of Emulate3D at b+m
3. bmPaintSim
 1. What is bmPaintSim
 2. Why did we use Emulate3D for bmPaintSim
 3. Introduction bmPaintSim
4. Future Outlook



- Fully integrated turnkey robotic paint lines
- Owner-operated • 465 employees • 85 m€ revenue
- **Global supplier for premium surface technology since 1992**

Use of Emulate3D in b+m

- Use of Emulate3D since 2013
- Close Partnership with SIMPLAN
- Full use of Simulation and Emulation



- Robotic and Dosing



- Process

- Conveyor

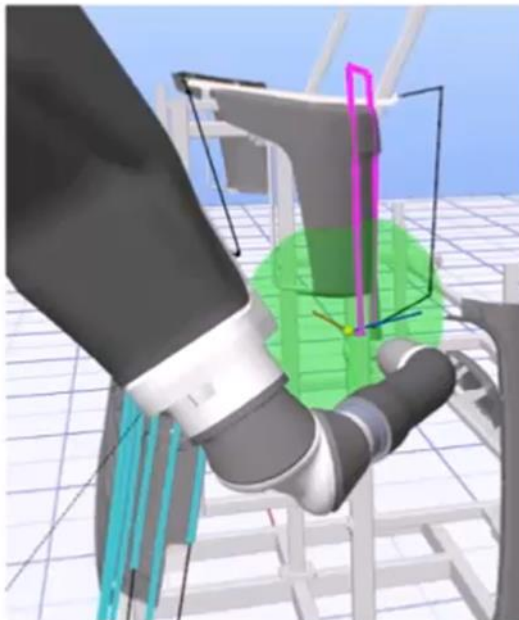
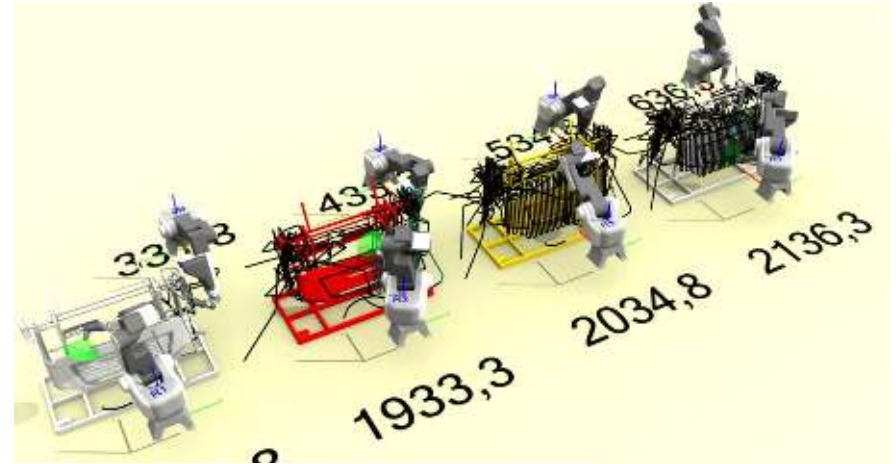


- b+m MES System



What is bmPaintSim ?

- Offline Robot Programming Tool
- Semi-Automatic Path Generation
- Designed for b+m Painting Robots
- Real Time/ Behavior Simulation

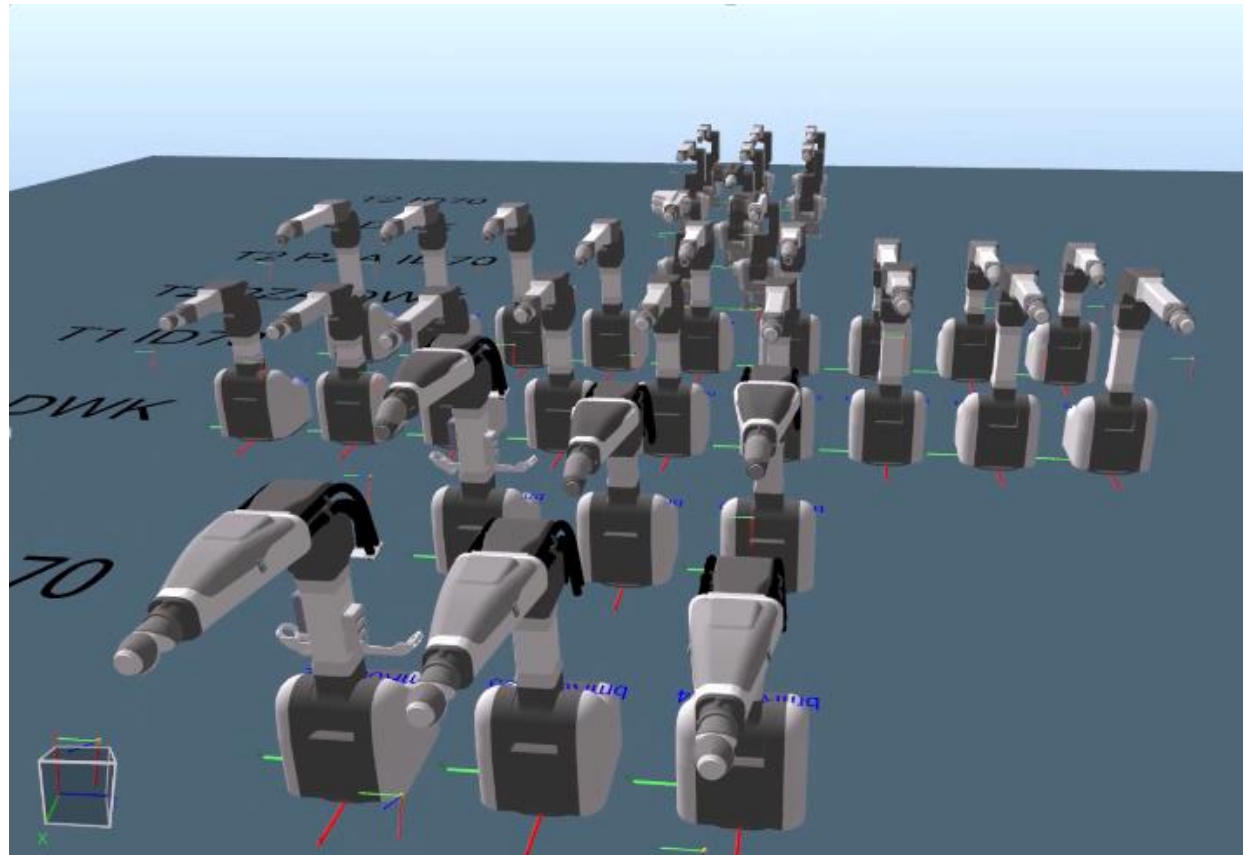


Why did we use Emulate3D for bmPaintSim

Pro	Con
Continues increasing requirements	b+m sells just ~< 50 Robots/a
Years of experience with Emulate3D	Potential of ~10-20 Licenses/a
Independ from 3 rd Parties	High dependency of Rockwell
Maximum flexibility for our customers	
Long term cost saving opportunity	

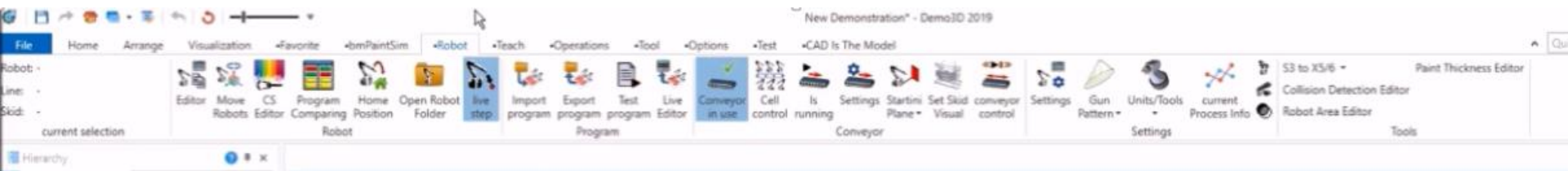
bm Robots in Emulate3D / bmPaintSim

- Painting/handling robots
- With/without external axis
- T1/T2/S1 Models
- X5/X6 Generations
- Different lengths
- Different tools
- Flaming/painting



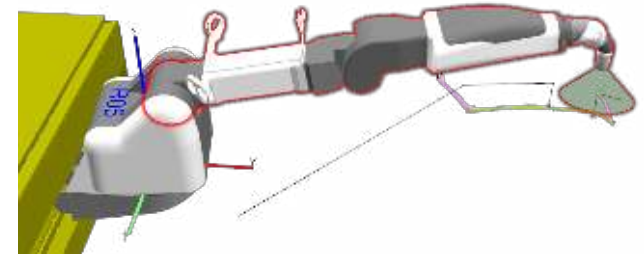
Using add-in for integrating bmPaintSim

- More than 50 windows
- More than 300 different functions



Errors Detection

- Limits
- Percentage colored

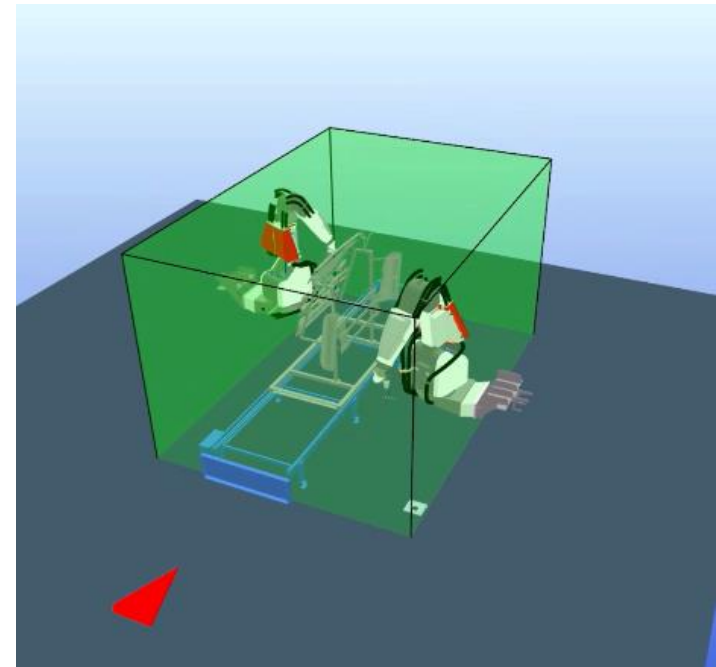
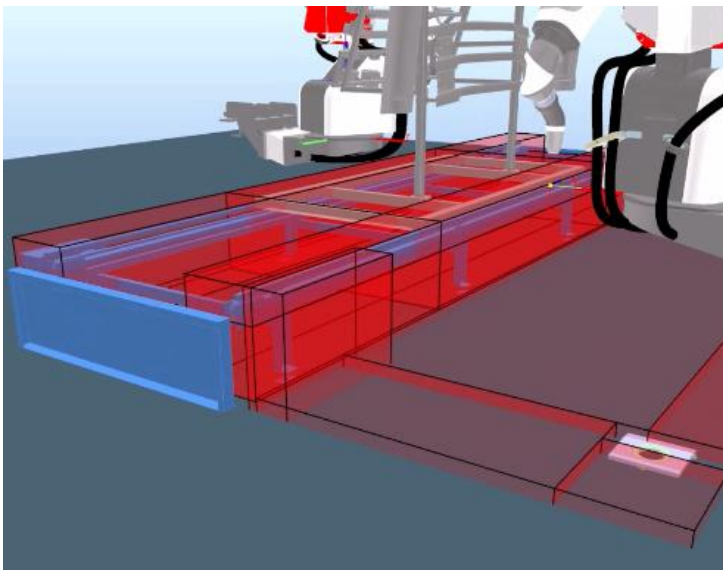
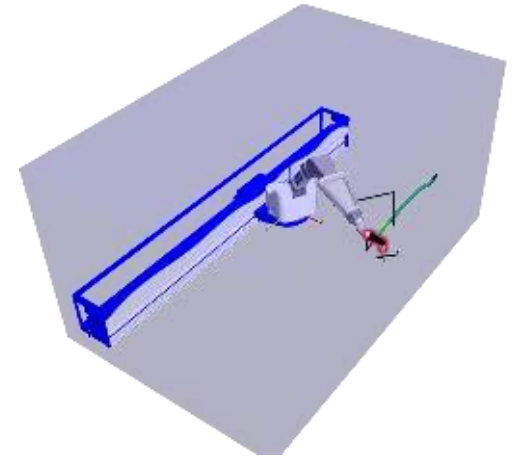


Nr	Description	X	Y	Z	A	B	C	Lx	Ly	
58	120	SMOVE LINEAR	581.2	-456.1	828.2	-148.0	-181.5	-177.3	-2000.0	0
59	120	SMOVE LINEAR	781.3	-625.3	1010.7	-148.2	-159.0	-176.3	-2000.0	0
60	120	SMOVE LINEAR	985.9	-580.3	1080.1	-189.4	-141.7	169.0	-2000.0	0
61	69	USE BRUSH	58							
62	120	SMOVE LINEAR	989.7	-389.4	1187.3	-190.0	-154.8	167.9	-2000.0	0
63	120	SMOVE LINEAR	961.7	-594.9	1119.6	-190.0	-155.0	170.0	-2000.0	0
64	120	SMOVE LINEAR	958.3	0.0	1129.3	-190.0	-155.0	-180.0	-2000.0	0
65	120	SMOVE LINEAR	961.7	194.9	1118.6	-190.0	-155.0	-170.0	-2000.0	0
66	120	SMOVE LINEAR	989.7	389.4	1187.3	-190.0	-154.8	-167.9	-2000.0	0
67	120	SMOVE LINEAR	985.9	580.3	1080.1	-189.4	-141.7	-169.0	-2000.0	0
68	69	USE BRUSH	52							
69	120	SMOVE LINEAR	781.3	625.3	1010.7	148.2	-159.0	176.3	-2000.0	0
70	120	SMOVE LINEAR	581.2	456.1	828.2	148.0	-181.5	177.3	-2000.0	0
71	120	SMOVE LINEAR	303.3	683.4	840.3	149.3	-163.1	178.3	-2000.0	0
72	120	SMOVE LINEAR	188.3	711.8	745.1	149.8	-164.8	179.4	-2000.0	0
73	120	SMOVE LINEAR	-11.0	753.8	692.2	190.7	-188.5	-179.2	-2000.0	0
74	147	SMOVE GUN OFF	-188.1	758.3	692.0	-154.0	-180.7	-149.7	-2000.0	0

Q1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-123	(91.11%)
Q2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-0.5	(0.63%)
Q3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-74.2	(97.63%)
Q4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	38.5	(2.67%)
Q5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-47.8	(3.32%)
Q6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-92.5	(6.42%)
Lx	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	(0.00%)
Ly	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	(0.00%)
Lz	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	(0.00%)

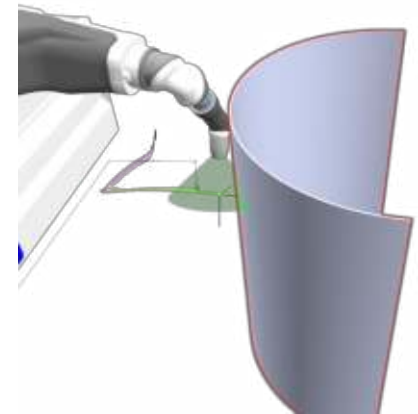
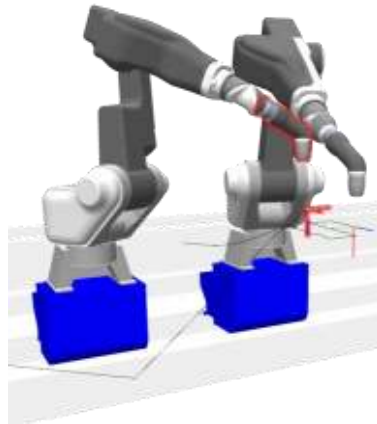
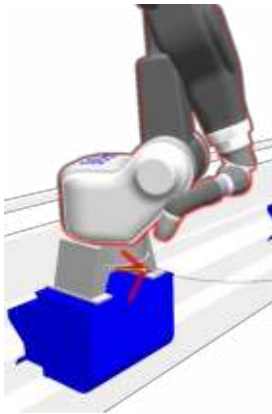
Errors Detection

- Workspace
- Restricted areas
- Create/Edit



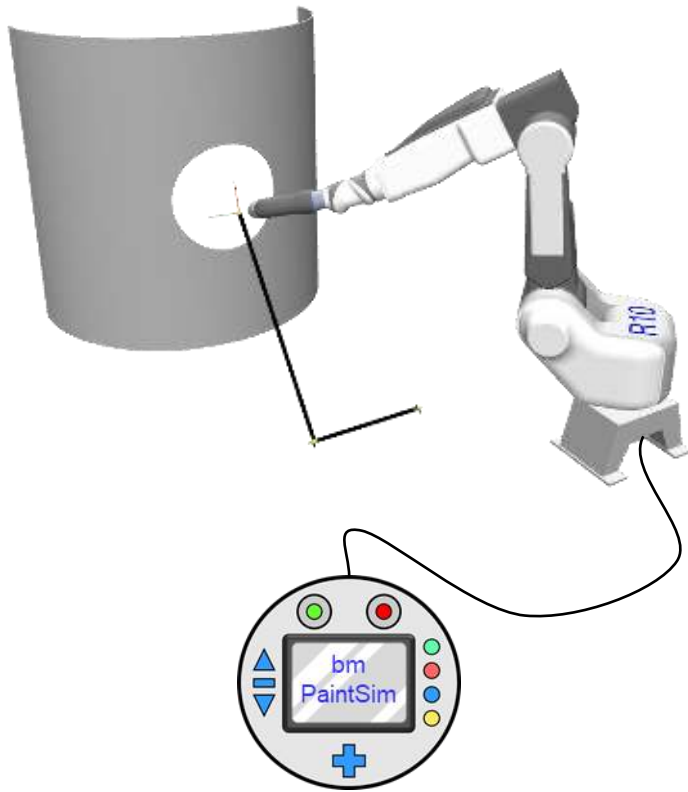
Errors Detection

- Collision by distance
- with robot itself/
- with other robots
- with CAD models

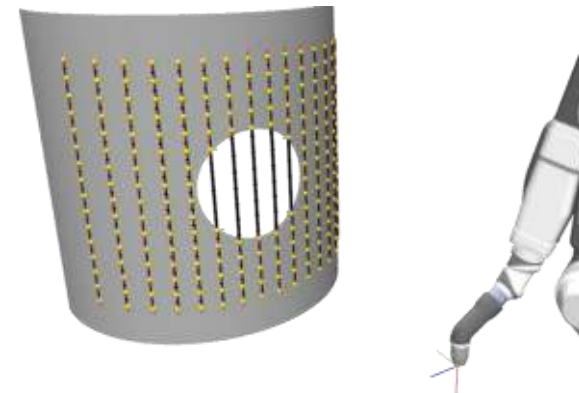


Creating Program

- Generating points with teach mode

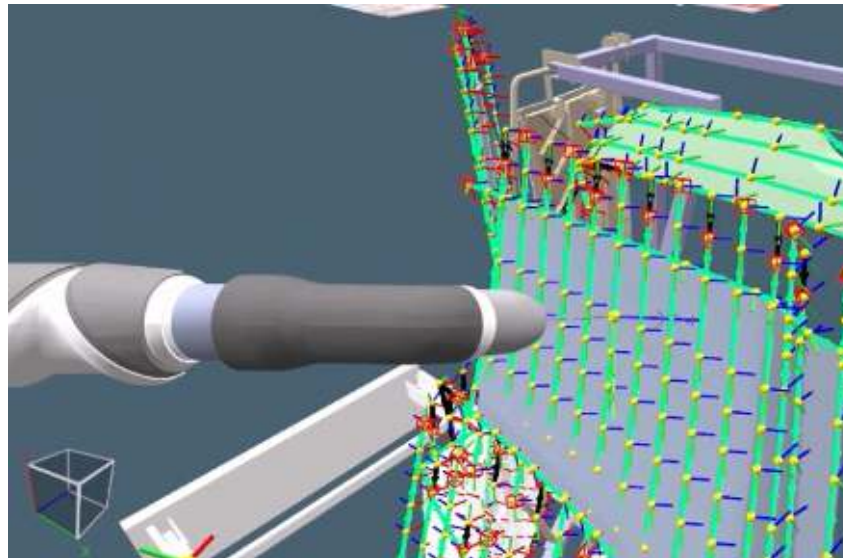


- Generating lines on the cad



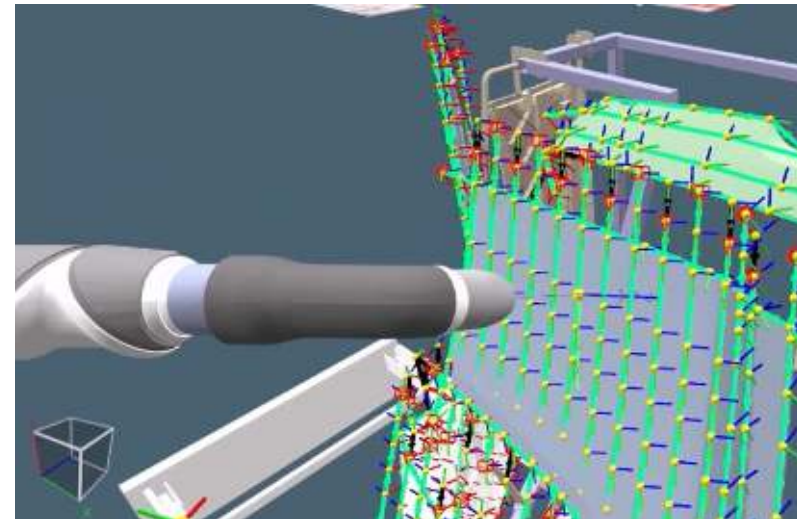
Create of Painting Programs at CAD Level

- Points are created on the surface of the CAD.
- Robot can jump to each points to allow optimization the position and orientation.
- Calculate the booth position for each point with sync.



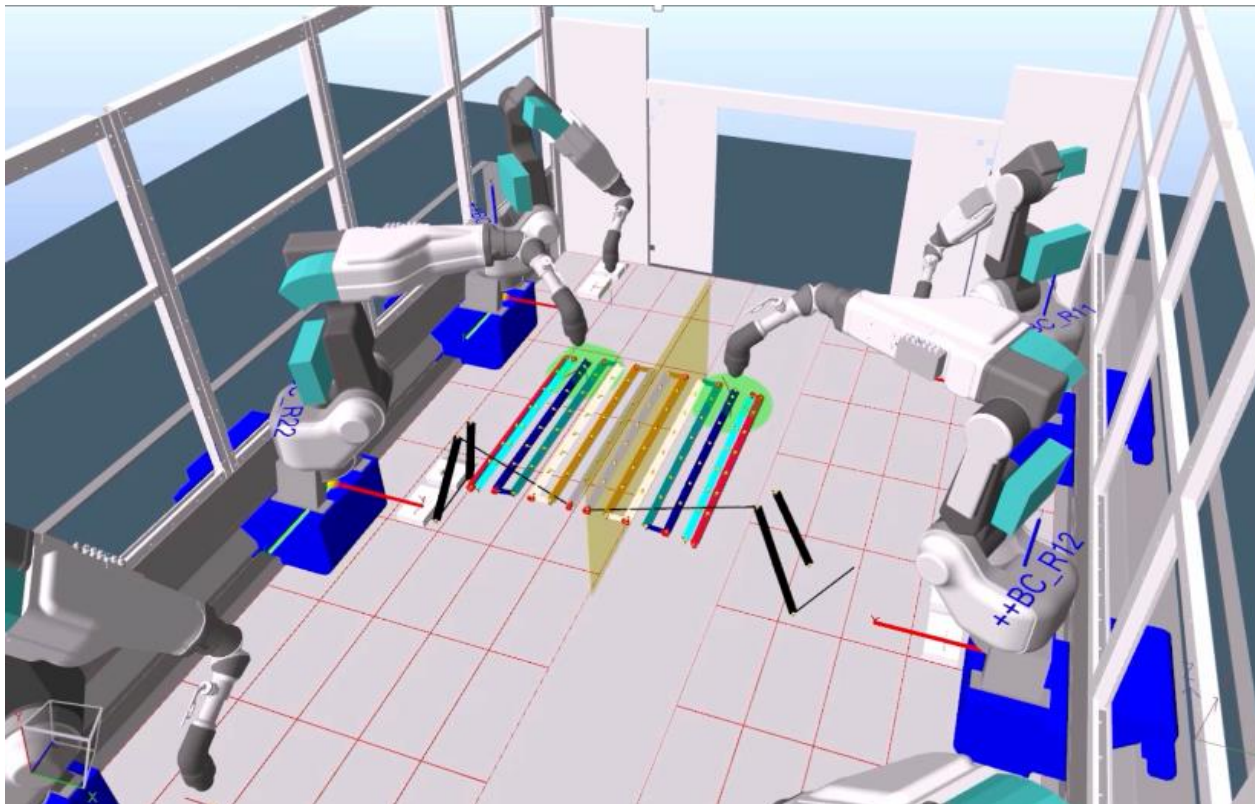
Create of Painting Programs at CAD Level

- Points are created on the surface of the CAD.
- Robot can jump to each points to allow optimization the position and orientation.
- Calculate the booth position for each point with sync.
- Change Parameter for each point separately .
- Gun on/off – Frame – Speed – Acceleration - MoveTyp PTP/Lin/Cir.
- Change the orientation/position of the points.
- Change the axis configuration.
- Optimize the orientation of the points.



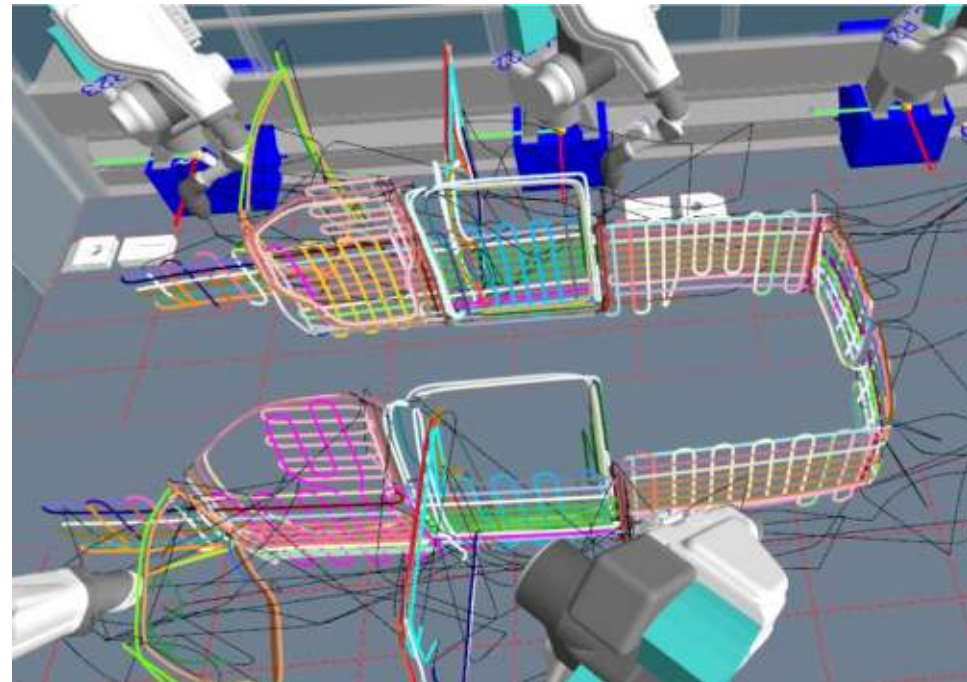
Mirroring a Painting Program

- Create a mirror plane.
- Mirroring the point position and orientation.



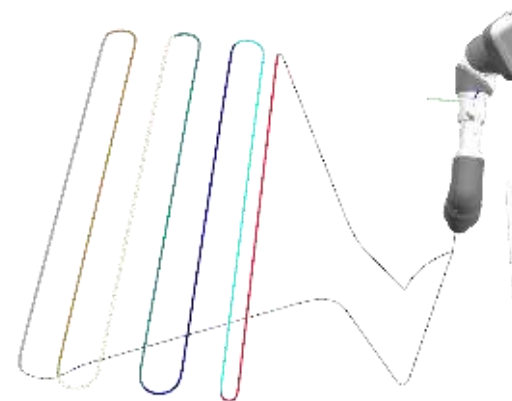
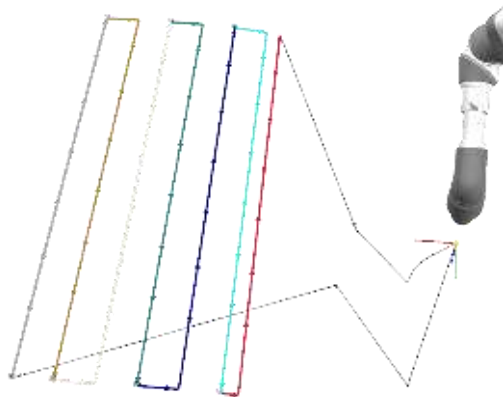
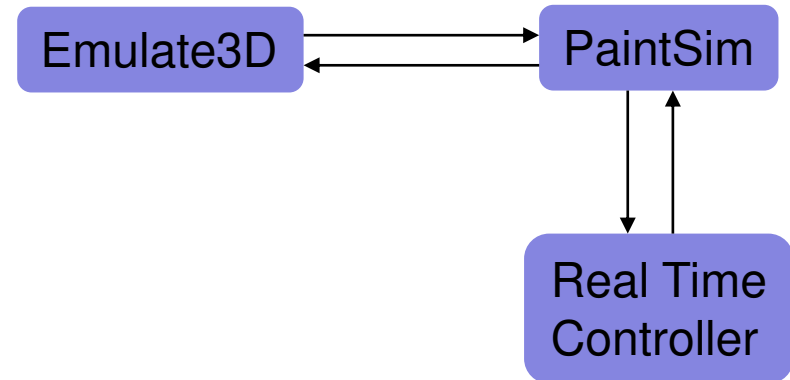
Cell Control

- Simulation of a multi-robot cell
- Connect the inputs and outputs between the robots
- Test the real interactions between robots in cell control.
- Testing of collision between robots
- Program time / Paint Consumption
- Robot trace:
 - black by gun off
 - colored by gun on
 - according to brush value
- Cycle time and feasibility analysis



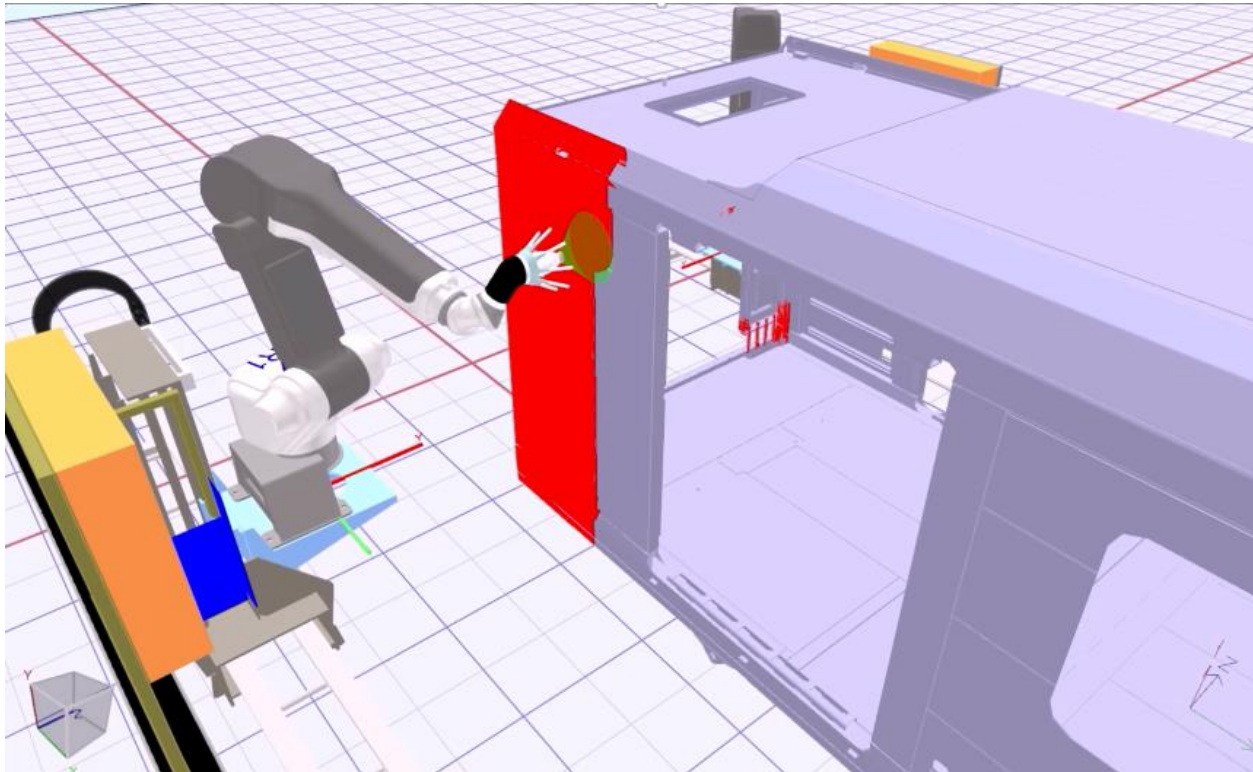
Real Time Controller

- Using a real time controller
- Giving real time of program
- Giving real trace of robot
- Giving real conveyor position
- Giving real program errors (Singularity/Limits..)



Future Outlook

- Show Painting on the CAD
- Calculate the painting layer thickness



Thank you for your attention!

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