

FINNISH LEARNINGS FROM ACTIVITIES IN THE GERMAN MARKET

Smart Factory Germany – Webinar
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Delfoi

Founded 1990 – spinoff from Technical Research Centre (VTT)

Two software segments:

- Delfoi Robotics – Offline Programming software suite
- Delfoi Planner - Advanced Planning & Scheduling + MES

Global business & technology partners:

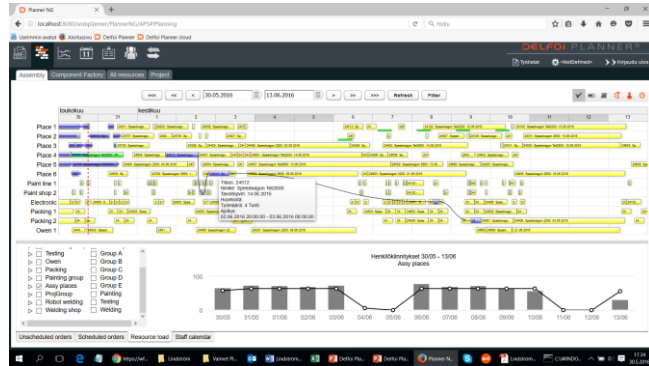
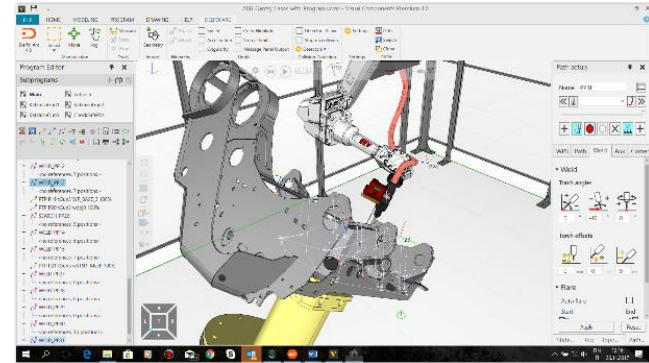


In offline programming (technology)



In Advanced Planning & Scheduling (channel)

Distributors in Europe, USA, South America, Asia, India



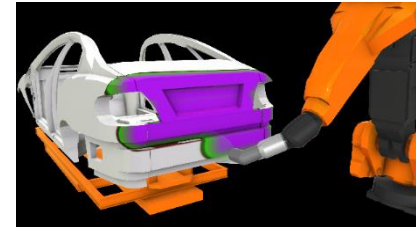
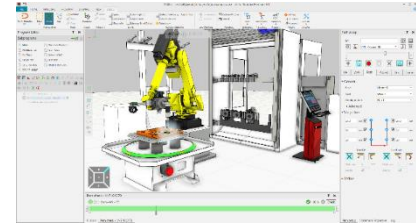
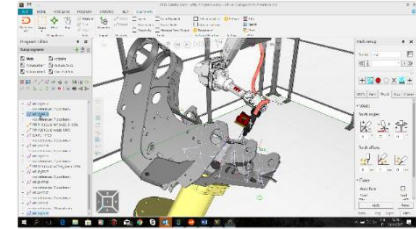
PARTNERS IN GERMANY

Value Adding Resellers (VAR) in DACH



FOCUS IN DELFOI ROBOTICS SOFTWARE

- **Robot off-line programming (OLP) software experience since 1990**
- **Main products**
 - Defoi ARC: arc welding, laser welding
 - Defoi CUT: cutting (beam and mechanical), finishing
 - Defoi PAINT: coating, painting (NEW in 2020)
- **Supported robot brands with robust postprocessors**



In 2020

From Digital design to Digital Robot Welding: 16 points in 3 sec.

The screenshot displays the DELFOI ROBOTICS software interface. The main window shows a 3D CAD model of a robot cell with a grey frame and a blue top surface. A 'Topology analysis' panel is open on the right, showing various analysis parameters and constraints. The interface includes a menu bar (FILE, HOME, MODELING, PROGRAM, DRAWING, HELP, Delfoi ARC), a toolbar with icons for Select, Move, Jog, Manipulation, Measure, Snap, Align, Attach, Detach, Import, Hierarchy, Limits, Detectors, Collision Detection, and various robot brands (CLOOS, OTC/Daihen, Yaskawa, Fanuc, Panasonic, KUKA, ABB, DelfoiTranslators). A 'Program Editor' window is open on the left, showing a 'Main' subprogram with a 'WELD_PP1' program. A 'Statement Properties' panel is visible on the far right. The bottom right corner of the software window shows 'Apply', 'Auto', 'Save', and 'Load' buttons, along with the text 'Topology analysis Path setup'.

Topology analysis

▼ Topology analysis

0 1000 1520 mm 10.6

Constraints

1 mm 90° 10 mm

Gaps

20 mm 20 mm

Circular

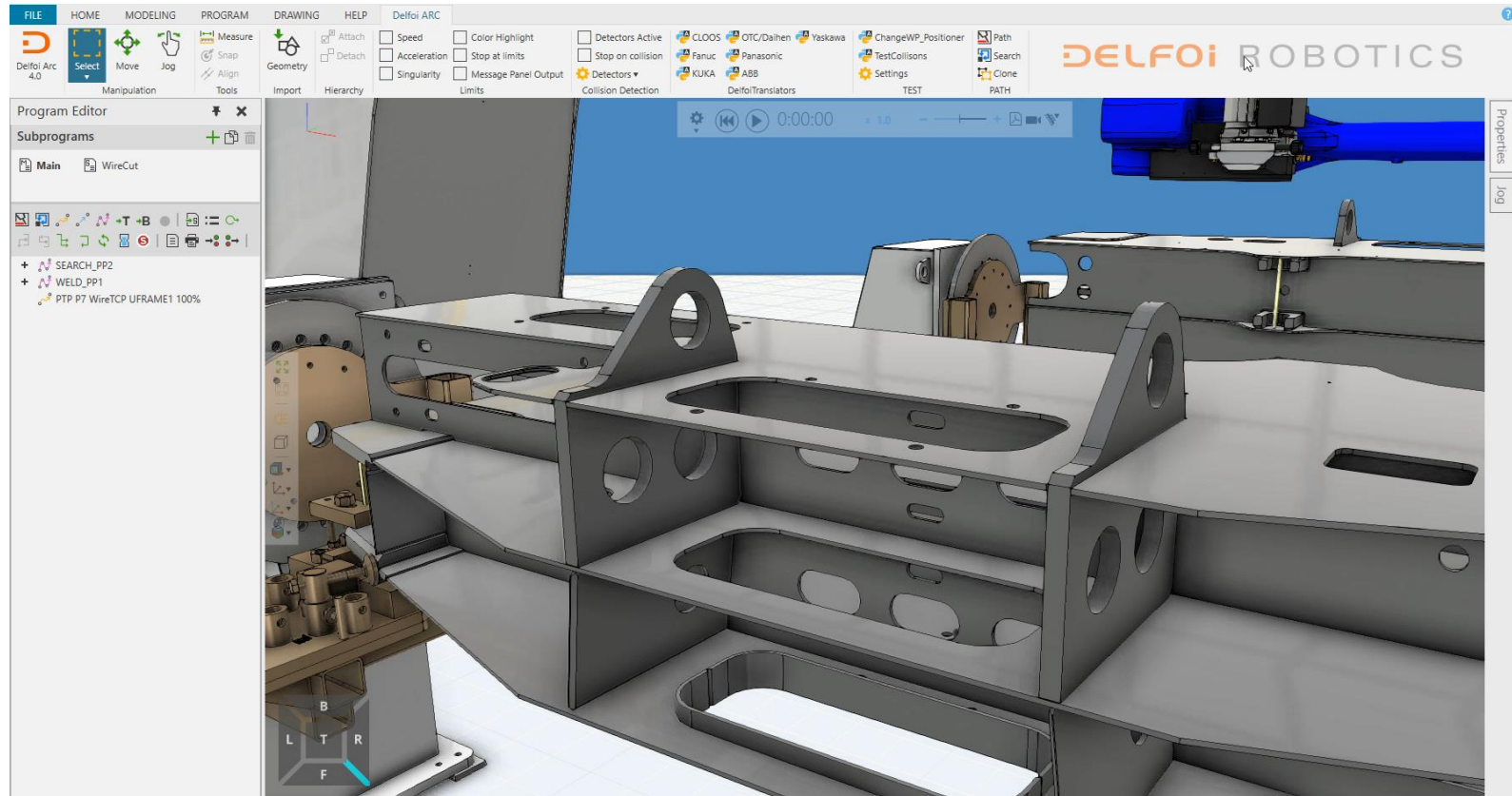
Sensitivity 75 %

Chordal angle 1°

Apply Auto Save Load

Topology analysis Path setup

Realistic Simulation and automatic path planning



Similar features – copying and cloning of paths: 168 teach points

The screenshot displays the DELFOI ROBOTICS software interface. The main window shows a 3D model of a robotic arm with a yellow track, positioned over a workpiece. The interface includes a menu bar (FILE, HOME, MODELING, PROGRAM, DRAWING, HELP, Delfoi ARC), a toolbar with various manipulation tools (Select, Move, Jog, Align, Tools), and a Program Editor on the left. The Program Editor shows a subprogram named 'WELD_PP1' with 21 positions. The Path setup panel on the right is active, showing the path name 'PP1' and various configuration options for the Gantry/Track and Positioner. The Gantry/Track panel includes options for Mode (Z+Wrist, Z+Point, Seam), a table of values (60, 0, 90, 75), and a table of limits (Link 1 limits: -180, -180, R; Link 2 limits: -360, -360, R). The Positioner panel includes options for Direction, Lock grill, and a table of limits (Link 1 limits: -180, -180, R; Link 2 limits: -360, -360, R). The DELFOI ROBOTICS logo is visible in the top right and bottom right corners.

FILE HOME MODELING PROGRAM DRAWING HELP Delfoi ARC

Delfoi Arc 4.0 Select Move Jog Manipulation Measure Snap Attach Geometry Import Hierarchy Limits

Speed Color Highlight Detectors Active Stop at limits Acceleration Stop on collision Message Panel Output Singularity Collision Detection

CLOOS OTC/Daihen Yaskawa ChangeWP_Positioner Path Search Clone

Fanuc Panasonic TestCollisions

KUKA ABB Settings

DelfoiTranslators TEST PATH

DELFOI ROBOTICS

Program Editor

Subprograms

Main

WELD_PP1

<no references, 21 positions>

Path setup

Name PP1

P1: Via. [J]

WPS Path Weld Aux Corner

Gantry/Track

MOVE AVG.

Mode Z+Wrist Z+Point Seam

60

0

90

75 %

Positioner

Direction - +

Lock grill Off

Link 1 limits * -180 -180 R

Link 2 limits * -360 -360 R

Apply Reset

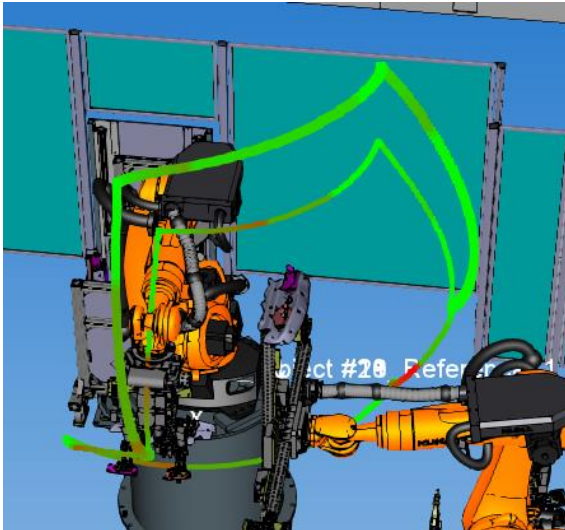
Statement Properties Jog

DELFOI ROBOTICS

RESEARCH AND INNOVATION ACTIVITIES

Delfoi path optimization – Daimler setup

- Energy saving optimization for robot tools paths
- Daimler has more than 5000 robots in Sindelfingen ...

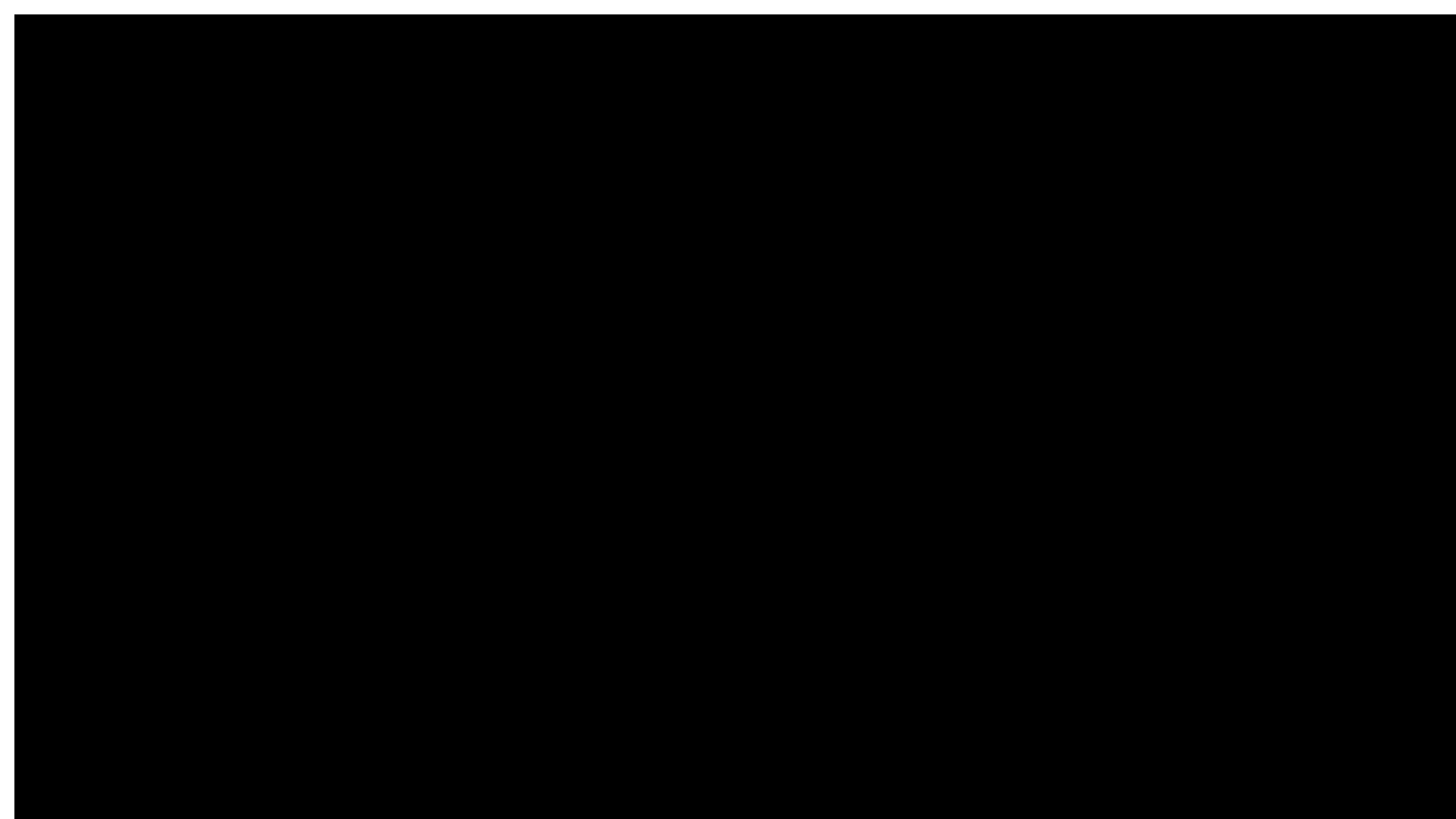


Full speed

Path	Timestep, [s]	Resolved	Energy, [J]	Time, [s]
path1	0.01	Yes	11258.52	3.055
path2	0.01	Yes	16152.45	3.509
path3	0.01	Yes	10026.57	3.296

Optimized speed

Path	Timestep, [s]	Resolved	Energy, [J]	Time, [s]
path1	0.01	Yes	9236.42	3.374
path2	0.01	Yes	13831.37	4.121
path3	0.01	Yes	8881.39	3.718

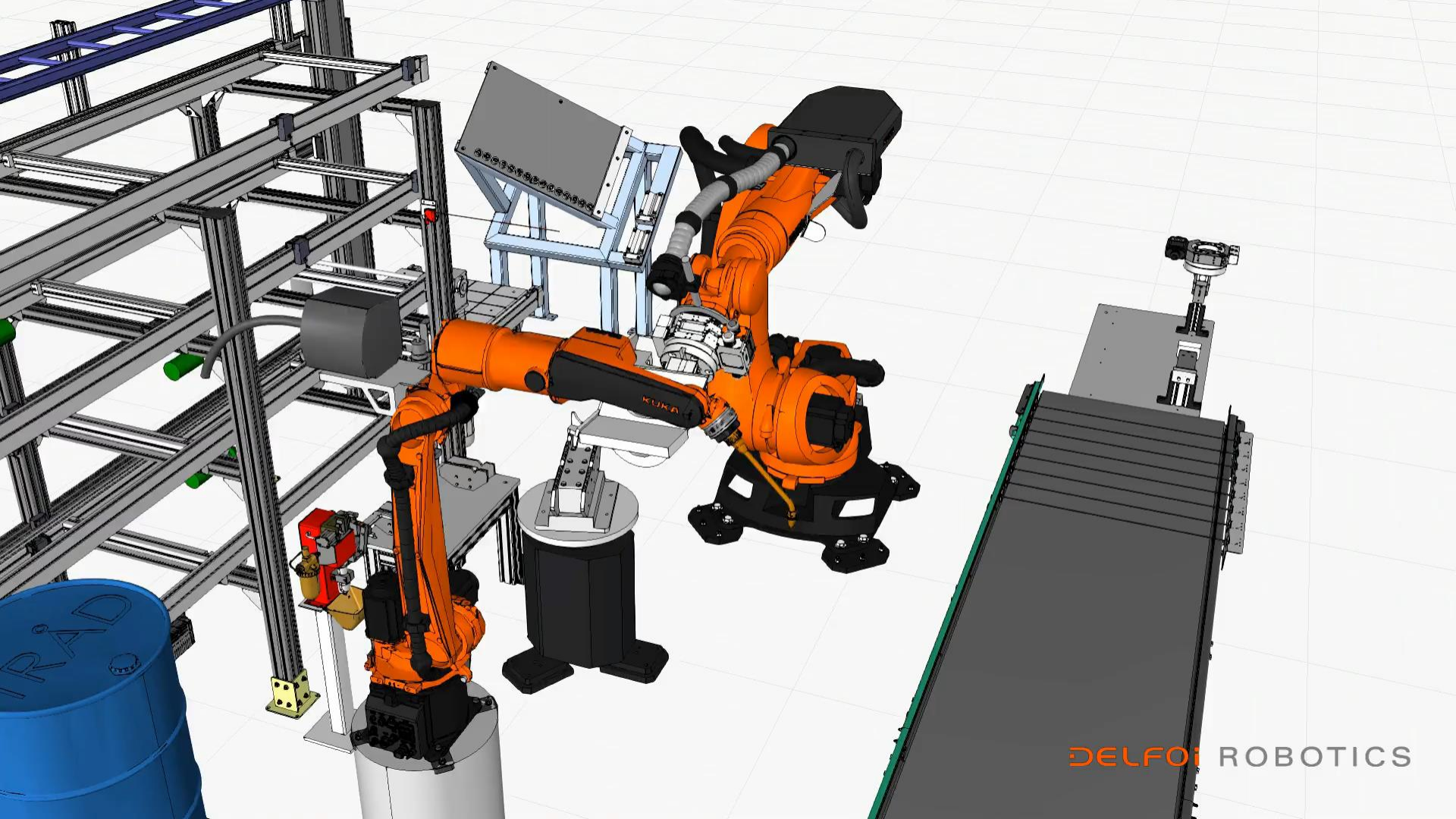


Developments within Industry 4.0 and Smart Factories

- JigLess Welding using multiple robots (Volvo, John Deere)
 - Part positioner robot, assembly robot, welding robot
 - No jigs or fixtures
 - Grippers as fixtures
 - Reversed assembly sequence
- Robot-Robot Collaboration for Laser Welding (EU Application)
 - Coordinated, synchronous motions for a laser welding system
 - Trumpf, Fraunhofer-IPA, DelfoiRobots
- Automatic path planning (Fraunhofer-IPA/Delfoi)
 - Automatic solving of trouble free tool paths
 - No collisions, No joint violations, No speed or acceleration violances, No singularity issues
- Ability to utilize maximally the CAD meta data (Systemworkx)
 - Weld process information > weld size, material, ...– welding parameter mapping

Automatic Path Planning

The screenshot displays the Delfoi Robotics Premium 4.1 software interface. The main workspace shows a 3D model of a car chassis with a blue robotic arm positioned to its right. The arm's path is visualized with red and blue lines, indicating the planned trajectory. The interface includes a top menu bar with options like FILE, HOME, MODELING, PROGRAM, DRAWING, and HELP. Below the menu is a toolbar with various icons for file operations, modeling, and programming. On the left, there is a 'Program Editor' panel with a 'Subprograms' list containing several PTP (Point-to-Point) tool paths, such as 'PTP P1 Tool1 Base1 100%'. At the bottom left, a 'Path check - SRA100-B' window is open, showing a 'check' button. On the right, a 'Statement Properties' panel is visible, displaying settings for the selected statement, including coordinates (X, Y, Z), name (P6), configuration (RAN), and various parameters like CycleTime, JointSpeed, JointForce, AccuracyMe, and AccuracyValue. The Delfoi Robotics logo is visible in the bottom right corner of the software window.



CUSTOMER CASES



- KUKA Roboter & Delfoi
- Laser welding

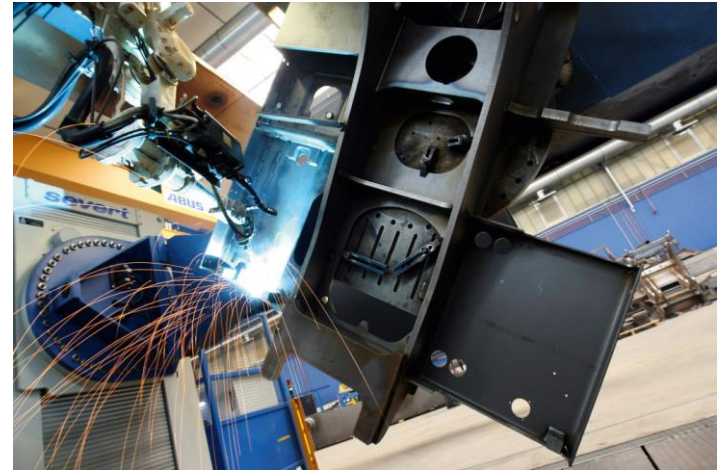
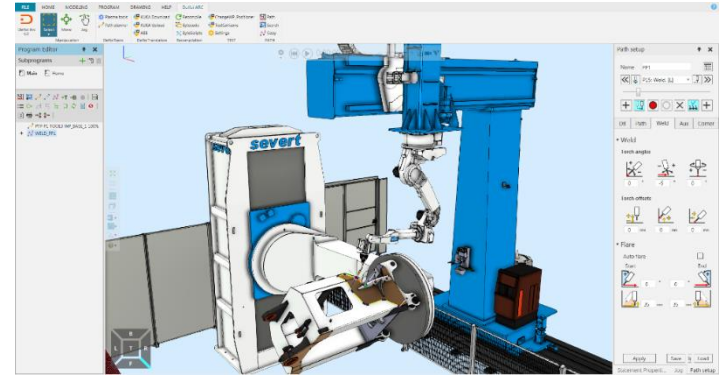


Background

- ✓ OTC and ABB robots
- ✓ Welding of heavy machine assemblies, defence
- ✓ System integrator: selling robot welding systems

Partner

- ✓ Delfoi's reseller partner in DACH – also globally



Background

- ✓ Long programming time by teaching: appr. 100h-120h per new machine frame
- ✓ Poor utilization rate of the robots
- ✓ 14 robot stations: 10 Yaskawa, 2 CLOOS, 2 ABB

Solution

- ✓ Offline programming of all robot brands

Results

- ✓ Appr. 20-30 working days saved in every new product launch
- ✓ Utilization of robots more than 93% > ability to manufacture more forest machines > increased sales potential
- ✓ Flexibility: new robot programs can be moved between robot stations



Background

- ✓ Yaskawa and IGM robots, more than 10 stations
- ✓ Welding of various forklift components
- ✓ Big robots as part positioners while smaller robots are welding
- ✓ Online programming is time consuming

Solution

- ✓ Offline programming for both robot brands

Results

- ✓ Programming stoppages minimized in the robot cells which are programmed offline (four at the moment)





– Heavy welding

Background

- ✓ Welding of various mining machine parts
- ✓ Long ramp-up times due to programming
- ✓ Welds with up to 30-40 passes

Solution

- ✓ offline programming software supporting all robot brands

Results – no measured results yet

- ✓ Pilot case: a big Yaskawa portal robot station
- ✓ welding track booms with plate thickness up to 50 mm.



Thank you.

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