RSU User Software

Processing Static and on the fly (OTF)

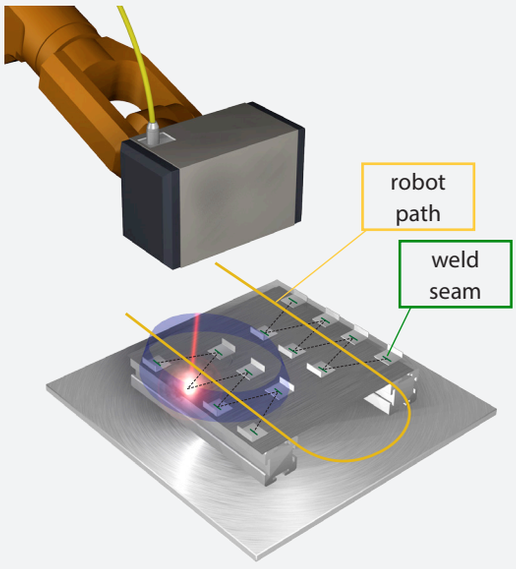
In order to extend the work space of scanner optics, an industrial robot, which moves the optics over the component, is usually used in the industrial environment. There are two possible movement concepts to approach all processing positions: static processing and OTF processing.

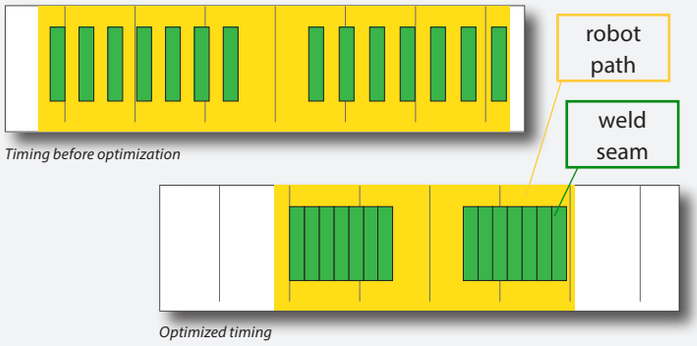
In the case of static processing, a sequential movement of robots and scanners takes place. The guiding machine moves the optics to defined positions in 3D space and waits until the laser processing is finished. During the standstill times, the scanner performs the welding operations and reports the completion of the task after the last seam to the robot.

The OTF movement is characterized by a parallel movement of the robot and the scanner. While the robot guides the scanner over the component, the optics performs the laser tasks. In this case, all axes are simultaneously in motion, which usually leads to a reduction in the cycle time in comparison to the static machining.

The timing between the scanner and the robot is essential for an optimized cycle time, especially in case of OTF welding. In addition to the determination where welding is performed, the timing software can also be used to define the time when the weld seams are processed. This can be manipulated by selecting the weld seam time slices (green) and shifting them in the trigger corridor of the robot (yellow).

This enables the user to optimize angles of incidence and to derive potentials for a faster movement of the robot.





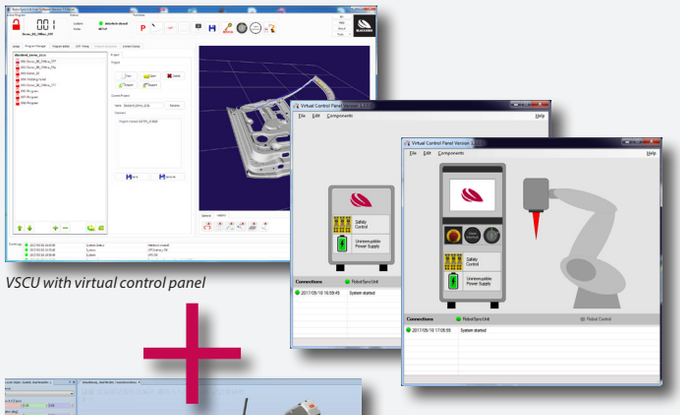
Timing before optimization

Optimized timing

Offline Programming Environment: Virtual SCU (VSCU)

The virtual SCU is an offline planning tool, which can operate independently of the controller and is designed to edit existing scanner programs. Together with ABB RobotStudio, offline path planning and virtual commissioning are possible, even in early phases of planning.

- Desktop version of the software with all functions and all add-on modules, installable on any Windows system
- Import, adaptation and export of projects without affecting the ongoing production
- Virtual control panel for simulating the signals from the PLC and from the scanner
- Interface to ABB Robot Studio with live coordinate stream, recording function and signal exchange



VSCU with virtual control panel

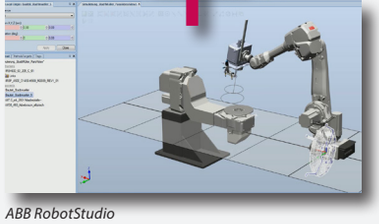


ABB RobotStudio

Software packages	2D Basis Software	3D Welding Static	3D Welding on the fly	Virtual SCU
2D welding elements (lines, splines, rectangles, ellipsis, spirals)	✓	✓	✓	✓
Robot coordinate stream	✗	✓	✓	✓
3D welding elements	✗	✓	✓	✓
On the fly - timing	✗	✗	✓	✓
Marking elements (text, bitmap, QR- and Barcode)	optional	optional	optional	✓

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RSU User Software

Smart Welding

Using the RSU user software, 2D and 3D scanners of the intelli*SCAN* and intelli*WELD* product lines can be programmed. This includes amongst others the movement of the deflection mirrors, the Z axis and the communication to the laser. Essential input parameters for this are the positions of the scanning head and the welding seams in 3D space. Scanners can be loaded into the system by means of a so-called SDP (scanner description) file and are then available with their individual attributes for programming. The software communicates via fieldbus with the robot, which carries the scanner, and with the superordinated controller (generally PLC). Thereby, live coordinates of the scan head, robot track recordings as well as states of peripherals and user-defined variables (e.g. component serial number) can be transferred. An import of 3D CAD components makes navigation easy in the 3D scene and simplifies the programming of the welding seams with the function of edge extraction. In addition, any seam geometry can be loaded into the software using a DXF import.

All welding seams can be set individually with all process parameters needed for remote welding. The programming permits both the static case, in which the robot axes and the scanner axes are alternately moved, as well as the so-called welding on the fly, in which all axes are used parallel. The movement of the scanning head by the robot as well as the movement of the laser beam on the work piece can be supervised and simulated at any time. With the aid of the timing diagram, on the fly programs can be optimized with respect to cycle time and the angle of incidence. The interface is clearly structured and understandable even for unexperienced user. An intuitive menu guidance facilitates the access to the software and the interaction with the system. The software monitors all safety-relevant states of the scanner and the control. Extensive diagnostics, monitoring and recording functions help the user to keep an eye on the status of the system and, if necessary, to intervene selectively. A user administration with different authorization levels allows restricted access to crucial parts of the software or for modification of production programs. The software is also available as an offline version, which is used to edit programs without interrupting the processing at the plant. With an optional interface to ABB Robot Studio, detailed and precise offline path planning for virtual commissioning can be realized.

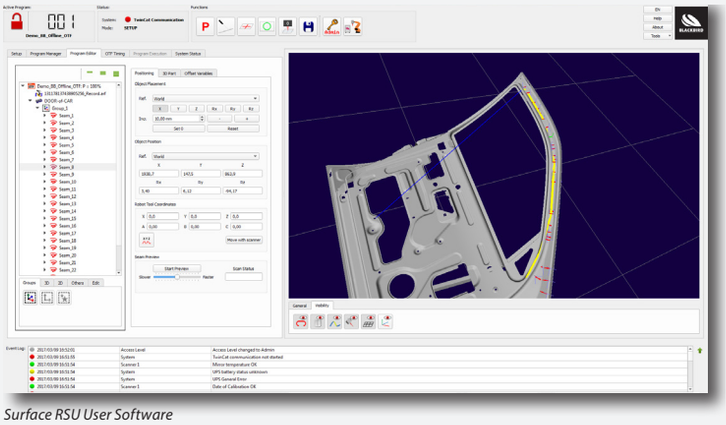
A professional training on the RSU user software carried out by our service personnel makes it easy to set up even demanding programming in the shortest possible time.

BLACKBIRD

RSU User Software

Software Interface

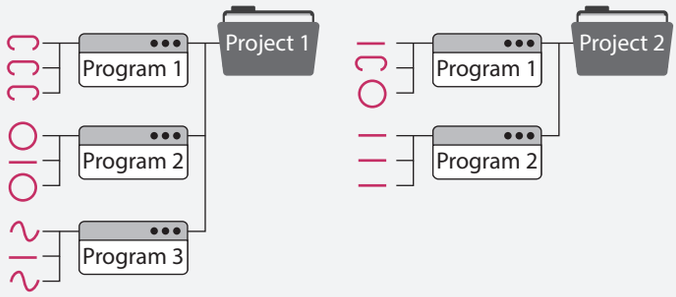
User-friendliness and intuitive working are the motivation for the design of the interface of the RSU user software. The status bar at the top of the screen provides quick access to frequently used commands and information about the current status of the system. In the form of registers below the status bar, an easy navigation through the different surfaces is given: setup of the system, administration, editing and execution of programs, detailed system status. The right side of the software is reserved for the 3D scene showing the scanner, 3D parts, seams and paths. An event log at the bottom of the screen informs about the current status and errors.



Surface RSU User Software

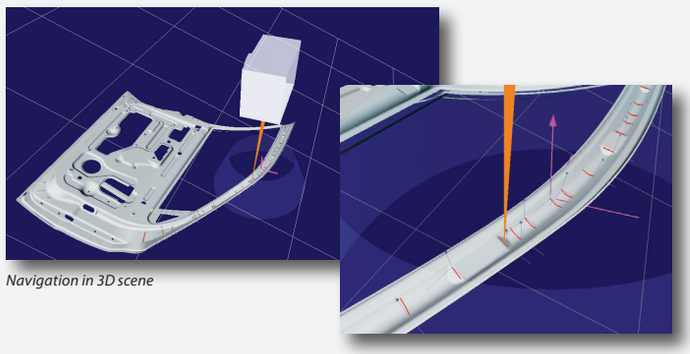
Organization

Within the RSU user software, a hierarchical structure consisting of elements, programs and projects. Individual welding seams are grouped into programs, several programs form projects. For the storage of backups, entire projects can be saved and reloaded. Therefore, it is always possible to return to a specific point in time of programming. For a better orientation in the project tree, all projects, programs and welding seams can be named individually.



Navigation

Apart from project trees, weld seams and other program elements (CAD components or robot records) also appear in the 3D scene, which provides a spatial representation of the geometry elements. The mouse can be used to navigate easily in the scene and to directly select weld seams. A model of the scanner with the laser beam represents the current position of the optics and the beam focus in space.



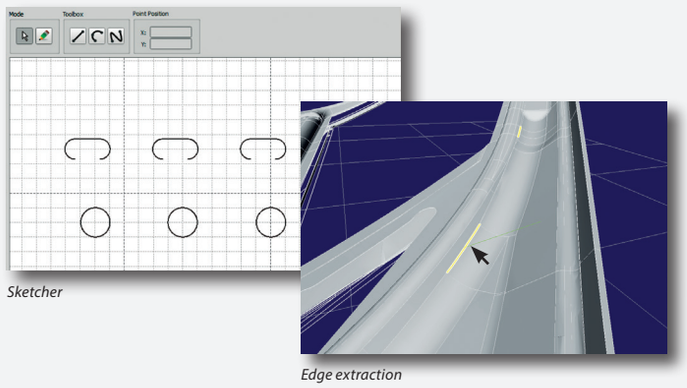
Navigation in 3D scene

Programming

The RSU user software provides various possibilities for the geometrical definition of welds, their position in 3D space and the assignment of process parameters. The choice of the method follows personal preferences or technical constraints and can always be a combination of the following options.

<u>Geometry</u>

- Points of reference: connect points to a trajectory
- Import: load 2D geometries via DXF directly from CAD software
- Sketcher: draw on a 2D surface, with lines, arcs, and spline elements
- Edge extraction: select component edges and pre-defined welds from 3D CAD components
- Primitives: select parameterizable standard shapes (rectangles, ellipses and spirals for Laser Screw Welding)
- Marking elements: integrate texts, images and bar / QR codes, variable content via bus interface

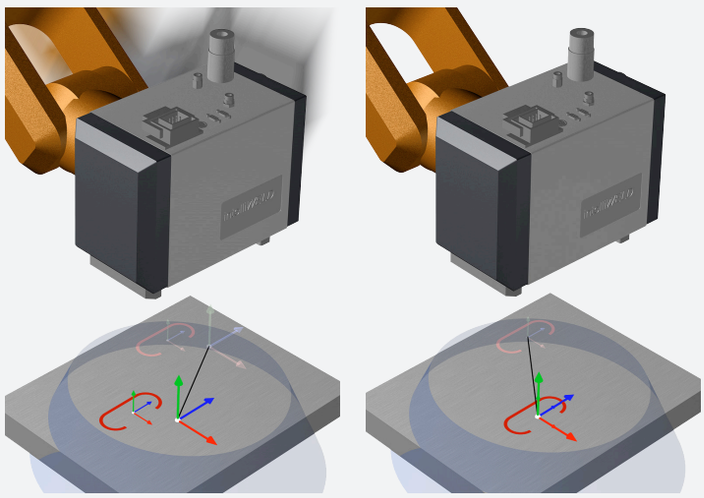


Sketcher

Edge extraction

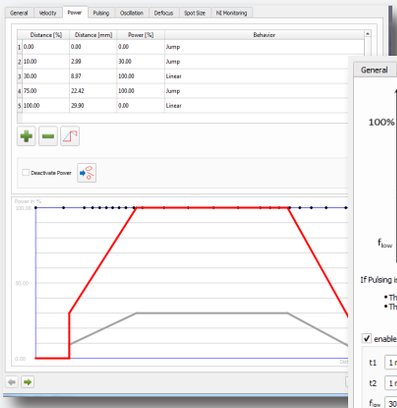
<u>Positioning</u>

- Move with robot: Temporary connection of the coordinate system of the seam with the TCP of the robot, manipulation of the position by moving the robot
- Shift to TCP: Shifts the seam to the current position of the robot TCP
- Coordinates input: Allows a shift and twist of the coordinate system of the seam in all spatial directions

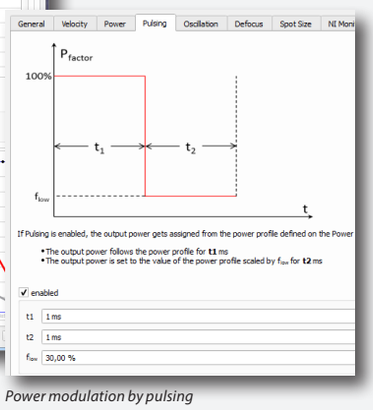


Move with robot

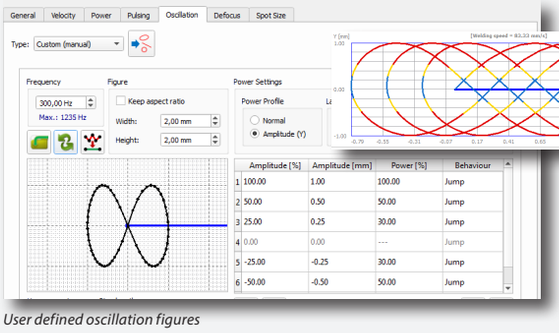
Shift to TCP



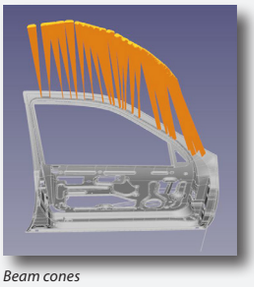
Parameterization of laser power



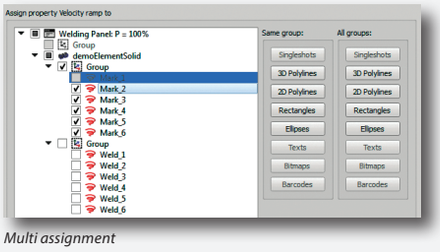
Power modulation by pulsing



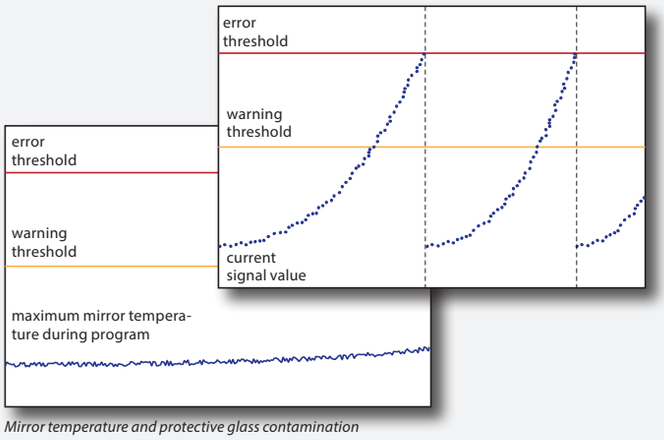
User defined oscillation figures



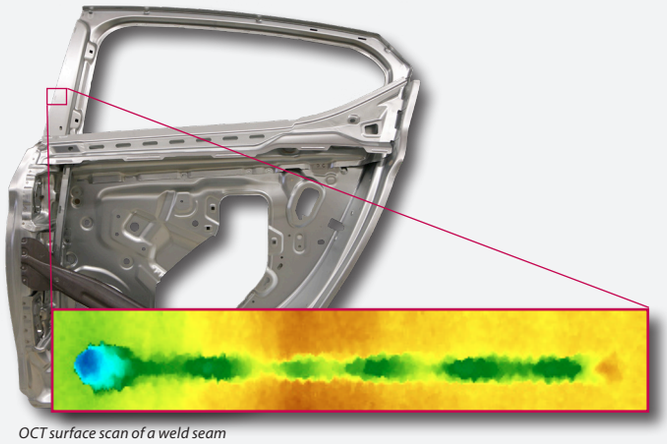
Beam cones



Multi assignment



Mirror temperature and protective glass contamination



OCT surface scan of a weld seam

Parameterization

- Assignment of seam properties, like
  - Feed rate
  - Laser power
  - Defocusing
  - Spot size (zoom)

  with individual customer profiles and graphical display
- Power modulation in the form of rectangular pulses: upper (red line) and lower (gray line) follow the preset along the seam, while lower level is reduced by a fixed factor.
- Superimposed Oscillation (wobble):
  - Standard oscillation
    - › Ellipse, horizontal eight and vertical eight, zig-zag and sine wave
    - › Parameterizable in size and frequency
  - User defined oscillation figures
    - › Import from CAD (.dxf)
    - › Parameterizable in size, frequency and power profile
- Multi assignment: Fast transfer of process parameters to
  - Individual seams
  - Seam groups
  - Sequence types (e.g. single shots, poly lines, 2D elements)

Export

- Beam cones: Collision analysis using the volumes the laser beam fills during processing. Export to 3D CAD formats (.wrl or .stl)
- Summary: Overview of all seams of a program with all parameters in an exportable table (.csv)

Diagnosis and Monitoring

Mirror temperature: constant, non-contact measurement and logging of the temperature of both mirrors. Used for early detection of dirt and damage. The exceedance of the warning or error threshold is communicated to the PLC.

- Protective glass contamination: Monitoring of the outer protective glass by means of scattered light sensors. The feature is used to control the degree of contamination and to determine the moment of exchange. The exceedance of the warning or error threshold is communicated to the PLC.
- Drift compensation: Compensation of the drift (offset and gain) by means of position sensors in the galvo. It is used to compensate long-term positional deviations in the mirror motors.
- Recording function: Optional recording of the position information of the scanning axes, values of all sensors as well as of the laser signal in the 10 µsec clock.
- System status: Overview of all relevant system components by means of intuitive traffic light system and display of measured value.

Interfaces

- Integration of the following sensor systems:
  - OCT (Blackbird): Edge tracking and quality assurance using a technology with point distance sensor
  - ScannerVisionSystem (Blackbird): Offline image processing
  - WeldEYE (Lessmüller): Edge tracking by means of image processing
  - VISIR (HEMA): Quality assurance systems using image processing