ABB Robotics Laser Cutting Software

High precision laser cutting made easy - Greater manufacturing flexibility at lower capital investment
Robotic laser cutting
Overview

- Allows for the increased use of light weight, high-strength steels and plastics.
- Commonly used for the cutting and trimming of hot stamped steel, hydro-formed parts, electronic parts and plastic parts.
- When other cutting processes are not precise enough, not cost effective, and not able to produce a high quality cut
Robotic laser cutting Applications

Automotive and General Industry:

- Ferrous material applications ≤ 6mm (0.25”) in thickness
- 3D contoured surfaces
- Hot stamped steel and hydro-formed parts
- Auto:
  - Upper car and truck body parts
  - A pillars, B pillars, dash board structures
- General Industry:
  - Oil & Gas
  - Aerospace
  - Material Handling Equipment – Forklifts
Robotic laser cutting
From pre-purchase to operation

- Low investment costs
  - Up to a 35% lower investment cost lower than traditional 5-axis laser cutting machines
  - Minimized floor space required
  - Possibility to eliminate existing operations (e.g. in-line cutting of hot stamped parts)
    - No trim presses required
    - Reduce or eliminate trim die costs
  - Ease of integration into manufacturing systems

- Productivity & Quality

- Flexibility

- Easy to use & Cost efficient

[Image]
Robotic laser cutting
From pre-purchase to operation

- Productivity comparable to traditional 5-axis laser cutting machines in this price range
- Part and shape dimensions are comparable to cutting machines
Robotic laser cutting
From pre-purchase to operation

- Low investment costs
- Productivity & Quality
- Flexibility
- Easy to use & Cost efficient

- Adapts to model / part changeovers and changes in model / part design
- Variety of cell configurations to meet a customer’s specific requirements, including multiple robots
- Capable to do multiple cutting processes for a variety of products
Robotic laser cutting
From pre-purchase to operation

- Generate and test robotic cutting programs in an off-line environment before production starts
- Fast and accurate tuning, calibration, integration and generation of programs on the robot controller
- Less operational costs (in-line example)
  - Workshop floor occupation and elimination of operations
- Lower spare parts cost
- Longer machine durability.

Low investment costs
Productivity & Quality
Flexibility
Easy to use & Cost efficient
Robotic laser cutting
Challenges and solution

Traditional challenges

- Programming, installation and operation of robots
  - Difficult to program; complex paths and shapes
  - Difficult to tune and calibrate; and to integrate with other machines and tools
  - Robot engineer needed to make operational adjustments
- High requirements on end product quality
  - Difficult to tune and calibrate a laser cutting robot to achieve the path accuracy required

ABB Software Solution

- Easy to program, install and operate
  - Off-line programming simplify generation of complex paths and shapes
  - Advanced online user interfaces support tuning, calibration, equipment integration and generation of complex paths and shapes
  - Customer specific operator interfaces to simplify operational adjustments
- Superior path accuracy for high quality end-products
  - Dedicated laser cutting software functions such as automatic friction tuning, iterative learning control, calibration and WristMove
**ABB’s Cutting Software**
Support programming, calibration, tuning & process integration

**Easy & quick to program**

**Easy to calibrate & tune the program precisely**

**Seamless integrate the process data for laser**

**Easy & quick offline programming**
- Design for end-user*
- Enhanced 3D path generation toolset based on CAD model*
- Path optimization & collision detection*
- Process Templates

**Easy & quick online programming**
- 2D/3D Cut instructions
- GUI for adjusting 2D shape arguments

**Easy to calibrate wobj**
- Standard calibration method, generate calibration routine based on CAD model*
- Calibration GUI in TPU*

**Quick shape tuning**
- Quick shape tuning*
- GUI for shape tuning

**Laser parameter table**
- Laser parameter table management in PC*
- Laser table in TPU*

**Support laser equipment**
- Standard interface & RAPID class for laser equipment
- Customizable HMI for laser equipment

**Easy to handle process**
- GUI for cut process state blocking

* New functions in version 5.15.01
ABB’s Cutting Software Overview

- **RobotStudio Cutting PowerPac**
  - Enhanced 3D path generation toolset based on CAD model
  - 3D path optimization, validation & simulation
  - Collision detection
  - Standard wobj calibration method
  - Laser parameter table management

- **RobotWare Cutting**
  - 2D/3D Cut instructions
  - Graphical operator screens for calibration, adjusting & tuning program, equipment control
  - Quick shape tuning
  - Activate/Edit/Save laser table in TPU
  - Standard interface for laser equipment
RobotStudio Cutting PowerPac
Concept overview

- Complete offline programming toolset for cutting applications
- Ease of use, designed for end-user engineer without robot experience.
- Enhanced 3D path generation toolset based on CAD model.
- New GUI for 3D path optimization and collision detection
- Standard work object calibration method
- Laser parameter table management

Easy and quick to program 3D paths offline
Easy to calibrate the program precisely
Seamless integrate the process data for laser
Easy to program and commission
RobotStudio Cutting PowerPac

- Off-line programming tool to generate cutting programs
- Generates 2D shape cut instructions based on geometry features
- Use of CAD models
- Free form path generation from geometry edges
- Pre-defined virtual signals for laser equipments
- Simulates and optimizes cutting programs
- Analysis to achieve constant TCP speed and accurate path
Easy to program and commission
RobotStudio Cutting PowerPac - Features

- Follow a program workflow supported by the software
  - Setup
    - Create 2D cut instruction based on geometry features or create free form path based on edges
  - Instruction/Path optimization and verification
  - Manage process data
  - Simulate the cut program
Enhanced 3D path generation toolset based on CAD model
- Automatically chaining edges
- Interpolation parameters of edges
- Simplified modification of tool paths
- Optimize tool rotation angle around z axis
- Standard work object calibration method with higher accuracy
Laser parameter table management

- Best practice management - Re-use and build experience database

- Laser table with most important cutting parameters

- Select what table to use for what laser cutting scenario

Main user interface features

- Tree view

- List all the existing laser tables

- Browse and edit laser tables
RobotWare Cutting
Concept overview

- Easy online program with the standard program editor
- 2D/3D Cut instructions
- Calibration GUI in TPU for operator
- Graphical operator screens for adjusting & tuning program, process control
- Quick shape tuning
- Pre-defined motion tuning data to improve the shape accuracy
- Activate/Edit/Save laser table in TPU
- Standard interface for laser equipment
- Customizable HMI for laser equipment

Easy & quick to program online
Easy to calibrate & tune the program precisely
Seamless integrate the process data for laser
Easy to program, commission and operate
RobotWare Cutting - Pre-defined user interfaces

Intuitive user interface – sophisticated online programming
- Predefined 2D shape generation Instructions
- Auto shape tuning integrated with cut instructions
- Standard cutting and laser equipment interfaces
- HMI - Quick argument checking & editing

Speed modulation
- Laser power can be modulated by robot speed

Customizable operator interface
- Made by Screen maker
- General equipment operator interface
Easy to program, install and operate
RobotWare Cutting - Shape generation

- Library of pre-defined 2D shapes and cut instructions; Hole, Slot, Rectangle, Hexagon, CAD
- Free-form cut instructions for 3D paths; Linear, Circular
- Automatic optimization and interaction to other cutting components (e.g. friction tuning, equipment classes, etc)
Easy to program, install and operate
RobotWare Cutting – Calibration and Tuning

- Calibration user interface for operator
  - Select calibration
  - Teach positions
  - Calculate unique calibration
  - Show results

- Graphical operator screens for adjusting & tuning program, process control
  - 2D shape list
  - Define 2D cut frame
  - Edit arguments of 2D cut instructions

- Quick shape tuning
  - Set max/min range for the friction value
Easy to program, install and operate
RobotWare Cutting – Integration of process data

- Best practice management - Re-use and build experience database
- Laser cutting tables
- Laser table management
  - Activate / Edit / Save
  - Browse and edit laser tables
  - One laser table active throughout the program
Easy to program, install and operate
RobotWare Cutting - Equipment interfaces

- Support various equipment such as laser sources, laser heads, etc.
- Customizable user interface supports integration of equipment classes
- Equipment specific functions controlled from dedicated classes
  - Standard process signals & mapping device IO to internal signals
  - Standard function interface for head control, laser control and gas control
  - RAPID template for laser equipment
Maximizing motor responsiveness, i.e. friction tuning, will result in optimum motion performance for:

- A specific shape
- At a specific location
- Automatic friction tuning method to find optimum performance
- User friendly HMI
- Each shape has a unique set of friction compensation values
Superior path performance
Example advanced shape tuning

**Test 1**

**Before**
Axis 1, FricLevel 40,
RMS 0.28 mm

**After**
Axis 1, FricLevel 160,
RMS 0.15 mm

**Improvement**
~45% of RMS

**Test 2**

**Before**
Mean/max deviation
0.67 mm

**After**
Mean/max deviation.
0.11 mm

**Improvement**
~85% of mean/max deviation
Superior path performance
RobotWare Cutting – Iterative Learning Control

- Measuring device incorporated to record the path shape
- Compares the recorded shape to the desired shape
- Generates offsets based on differences

Without ILC Tuning
- 0.38mm mean/max dev.

ILC Tuning*
- 1st. Iteration: 0.18mm mean/max dev.
- 2nd. Iteration: 0.16mm mean/max dev.

* = ILC improvements may be offset by the use of advanced shape tuning for some special cases
World best motion control
Standard ABB motion features

- TrueMove
- QuickMove
- WristMove
- BullsEye
- AbsoluteAccuracy
ABB Laser Cutting Software
High precision robotic laser cutting

- **Robotic Laser Cutting**
  - Up to 35%* lower capital investment
  - Higher manufacturing flexibility

- **ABB Laser Cutting Software**
  - Easy to program, install and commission
  - From program generation off-line to on-line installation and commissioning
  - High precision robotic laser cutting for high quality parts
  - Standard ABB Robotics motion features

* = actual investment savings compared to a 5-axis cutting machine will depend on customer specific conditions and requirements