

Robotics

ABB Robotics Laser Cutting Software

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

Robotic laser cutting

Overview



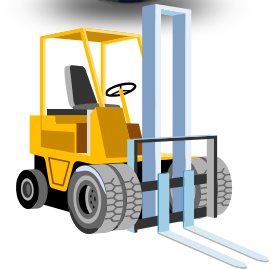
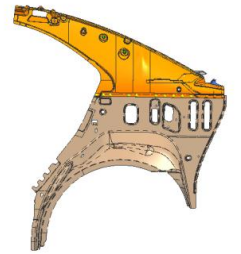
- Allows for the increased use of light weight, high-strength steels and plastics.
- Commonly used for the cutting and trimming of hot stamped steel, hydro-formed parts, electronic parts and plastic parts.
- When other cutting processes are not precise enough, not cost effective, and not able to produce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

Robotic laser cutting

Applications

Automotive and General Industry:

- Ferrous material applications $\leq 6\text{mm}$ (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



- 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

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



- 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.

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

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



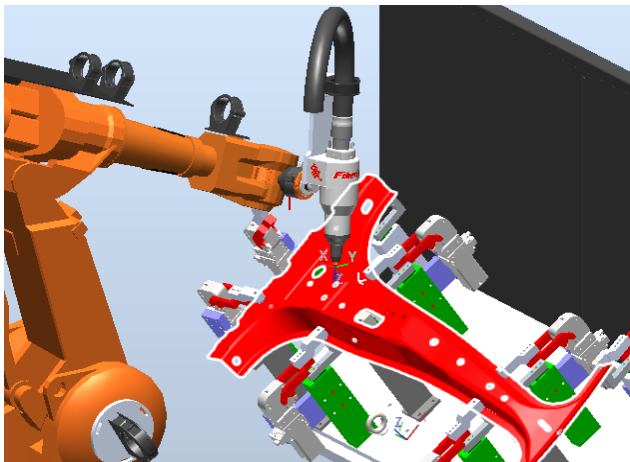
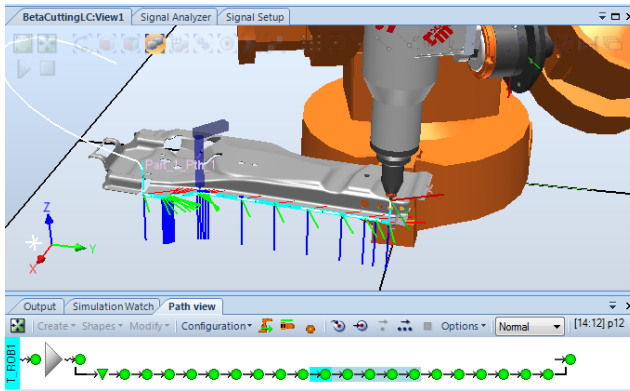
Easy and quick to program
3D paths offline

Easy to calibrate the
program precisely

Seamless integrate the
process data for laser

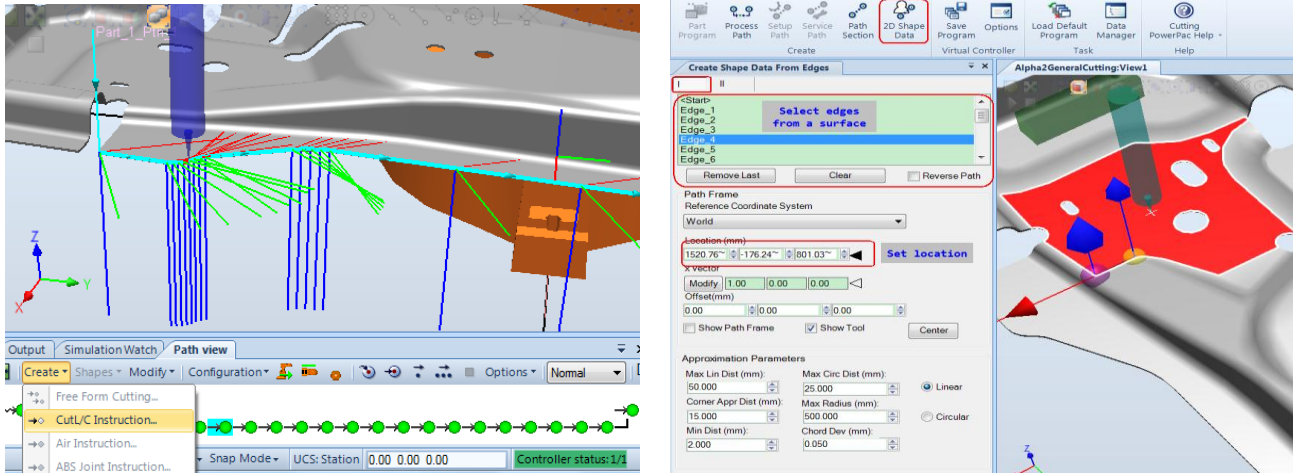
- Complete offline programming toolset for cutting applications
- Ease of use, designed for end-user engineer without robot experience.
- Enhanced 3D path generation toolset based on CAD model.
- New GUI for 3D path optimization and collision detection
- Standard work object calibration method
- Laser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

Easy to program and commission RobotStudio Cutting PowerPac



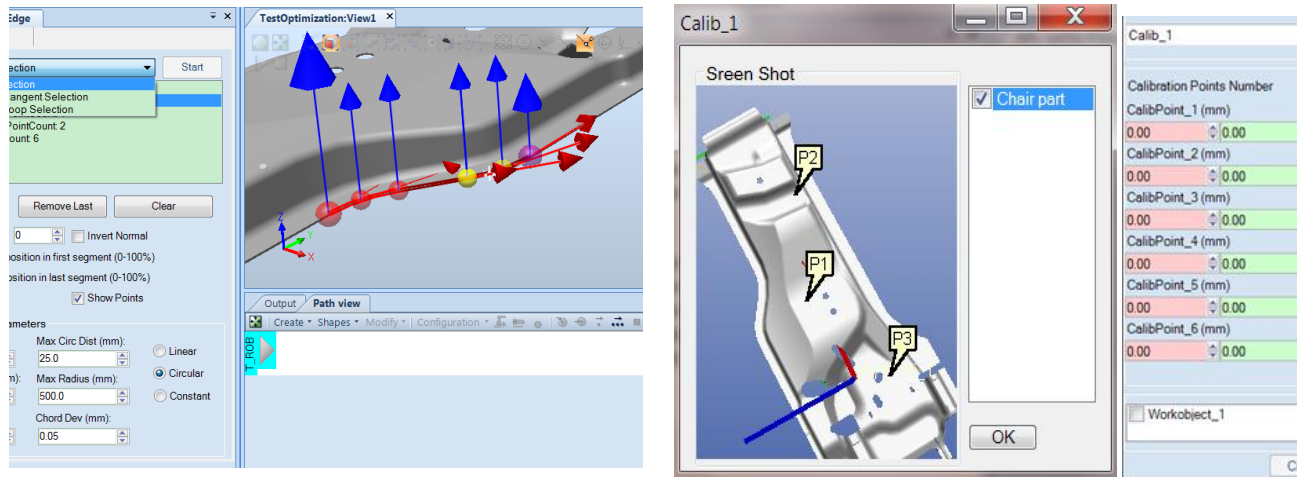
- Off-line programming tool to generate cutting programs
- Generates 2D shape cut instructions based on geometry features
- Use of CAD models
- Free form path generation from geometry edges
- Pre-defined virtual signals for laser equipments
- Simulates and optimizes cutting programs
- Analysis to achieve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

Easy to program and commission RobotStudio Cutting PowerPac - Features



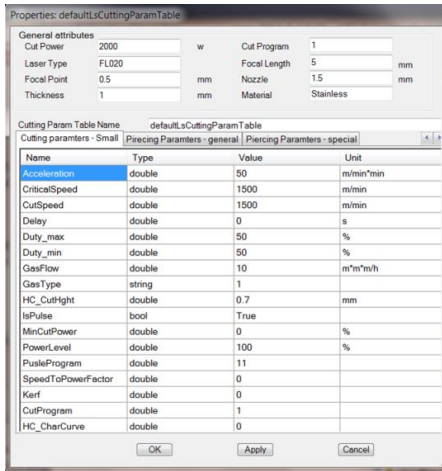
- Follow a program workflow supported by the software
 - Setup
 - Create 2D cut instruction based on geometry features or create free form path based on edges
 - Instruction/Path optimization and verification
 - Manage process data
 - Simulate the cut program

Easy to program and commission RobotStudio Cutting PowerPac - Features



- 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

Easy to program and commission RobotStudio Cutting PowerPac - Features



- **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 & quick to program online

Easy to calibrate & tune the program precisely

Seamless integrate the process data for laser

- 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 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

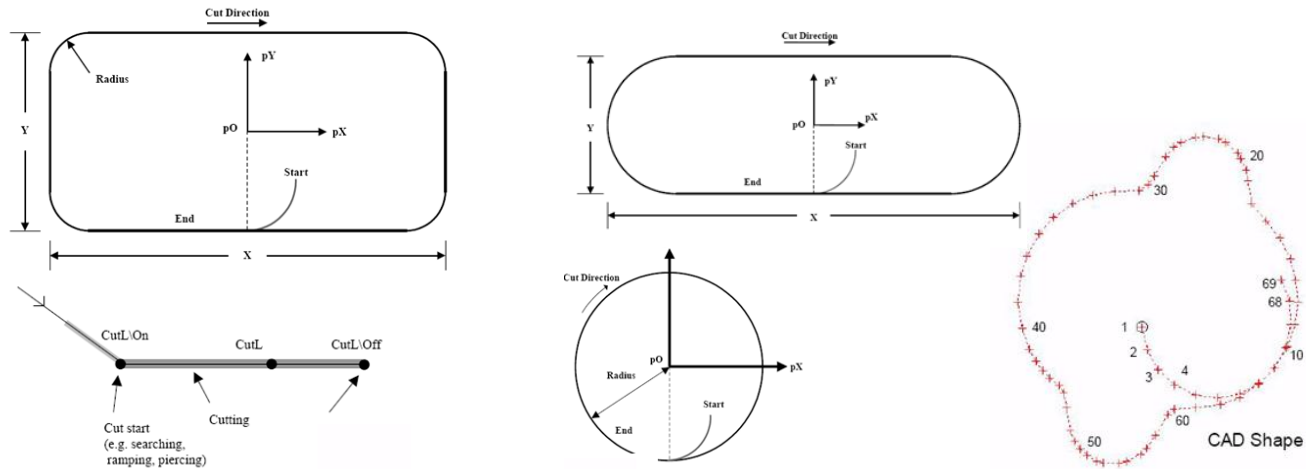
Speed modulation

- 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

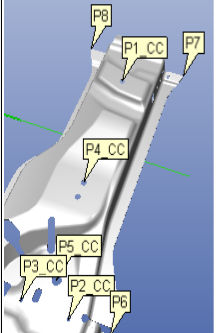


- Library of pre-defined 2D shapes and cut instructions; Hole, Slot, Rectangle, Hexagon, CAD
- Free-form cut instructions for 3D paths; Linear, Circular
- Automatic optimization and interaction to other cutting components (e.g. friction tuning, equipment classes, etc)

Easy to program, install and operate RobotWare Cutting – Calibration and Tuning

Calibration

Calib



P1_CC
P2_CC
P3_CC
P4_CC
P5_CC
P6
P7
P8

Result

Tool	MyTool
Wobj	myWobj_1
ErrMax	1.32222
ErrMean	0.69916
Date	2012-12-25

Point-1 ▼ GoTo Modify Calc Detail Setting

Shape tuning[T_ROB1][T_ROB1/mainMoudle]

Shape	Frc	Ilc	ID	ID
<input type="radio"/> CircleL	<input type="radio"/>	<input type="radio"/>	1	2
<input checked="" type="radio"/> CircleL	<input checked="" type="radio"/>	<input checked="" type="radio"/>	2	Circle, Diameter:10 Lin3_110_o3 ICW
<input type="radio"/> CircleJ	<input checked="" type="radio"/>	<input checked="" type="radio"/>	3	Frame ..., tool0, wobj1 pos2 pos2z
<input type="radio"/> CircleJ	<input checked="" type="radio"/>	<input checked="" type="radio"/>	5	Tuning fd_2[conflicting] [100,100,100,100,100,100] ILC:3 2011-05-23,19:48:19
<input type="radio"/> CircleL	<input type="radio"/>	<input type="radio"/>	4	Process cdvDefault CutSpeed: 60 , CutPower: 1 StandOff: 0 , LockHead: 0.1
<input checked="" type="radio"/> CircleJ	<input checked="" type="radio"/>	<input checked="" type="radio"/>	5	Offset ofs_1[conflicting]
<input checked="" type="radio"/> CircleL	<input checked="" type="radio"/>	<input checked="" type="radio"/>	7	
<input checked="" type="radio"/> CircleL	<input checked="" type="radio"/>	<input checked="" type="radio"/>	6	
<input checked="" type="radio"/> CircleL	<input checked="" type="radio"/>	<input checked="" type="radio"/>	6	
<input type="radio"/> CadL	<input type="radio"/>	<input checked="" type="radio"/>	7	

Settings Refresh Back

- **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

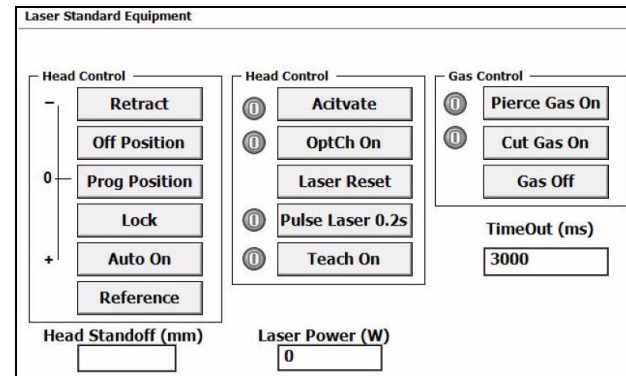
TableList					
Name	Robot	CutPowe	Materi	Thicknes	FocalPoint
aLSCuttingSysTe...		2000	AIS...	2	-0.5
cdvDefault		2000	AIS...	2	-0.5
defaultCuttingPa...	77		AIS...	2	-0.5
defaultLsCutting...		2000	AIS...	2	-0.5
(*defaultLsCutt...		2000	AIS...	2	-0.5
hhhh		2000	AIS...	2	-0.5
LSCuttingSysTem...		2000	AIS...	2	78
shaojieTest		2000	AIS...	2	-0.5
test		2000	AIS...	2	-0.5

EDIT ACTIVE BACK

- 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

Superior path performance

RobotWare Cutting - Advanced shape tuning



- 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

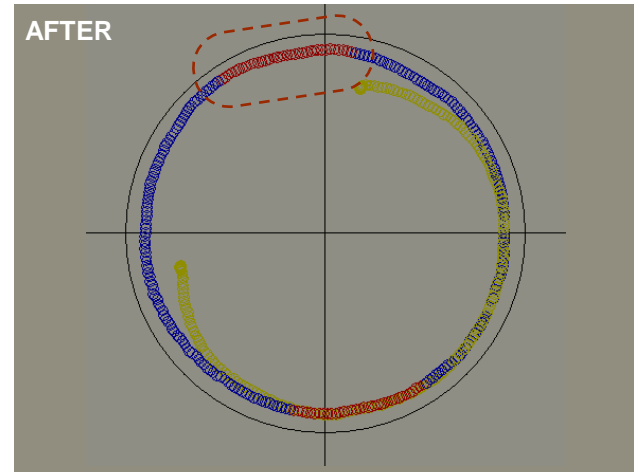
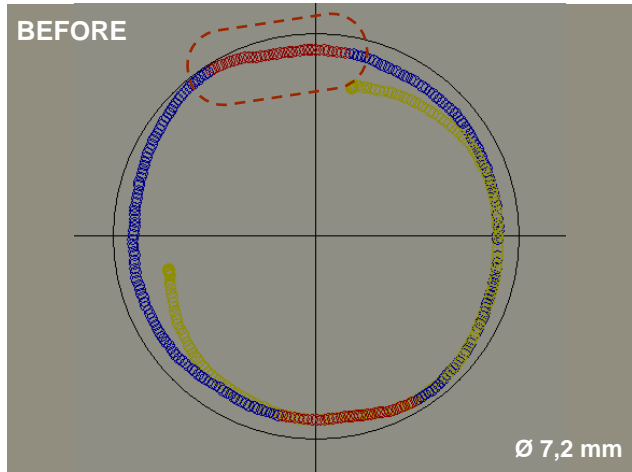
Axis 1, FricLevel 40,
RMS 0.28 mm

After

Axis 1, FricLevel 160,
RMS 0.15 mm

Improvement

~45 % of RMS



Test 2

Before

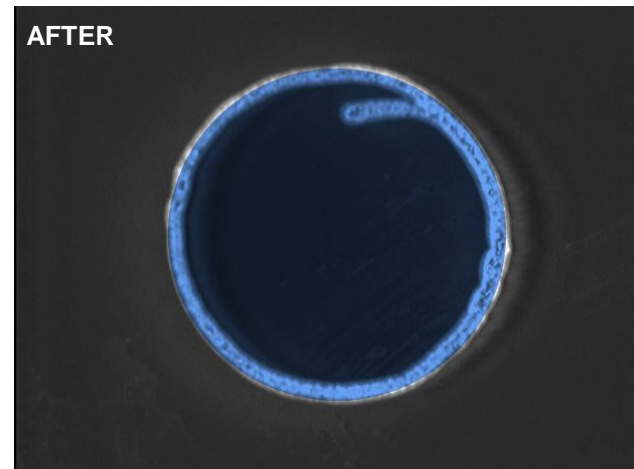
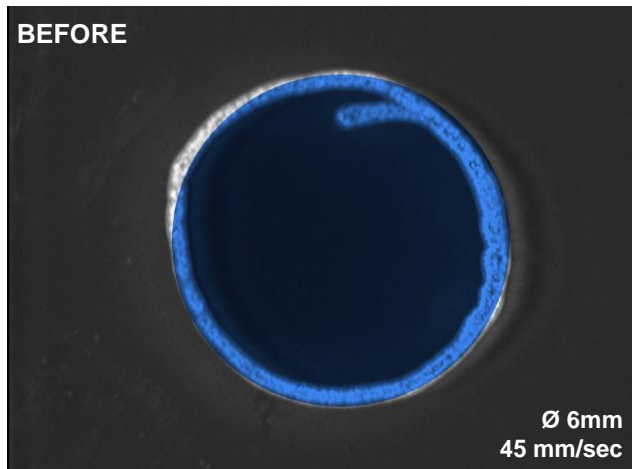
Mean/max deviation
0.67mm

After

Mean/max deviation.
0.11mm

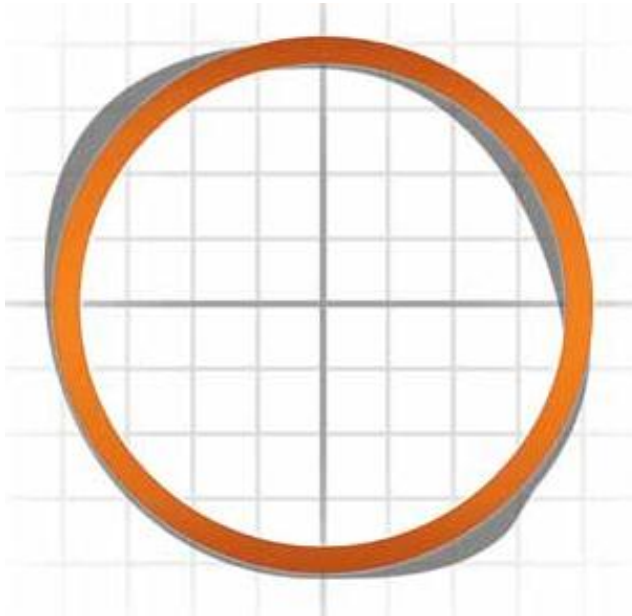
Improvement

~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

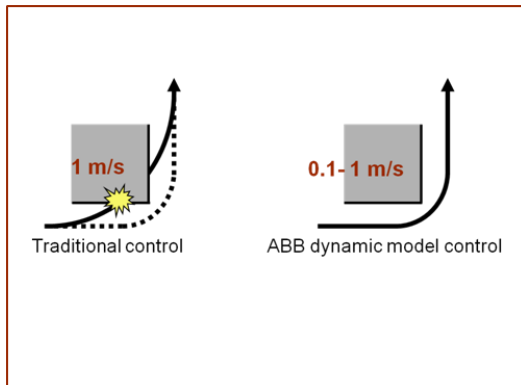
- 0.38mm mean/max dev.

ILC Tuning*

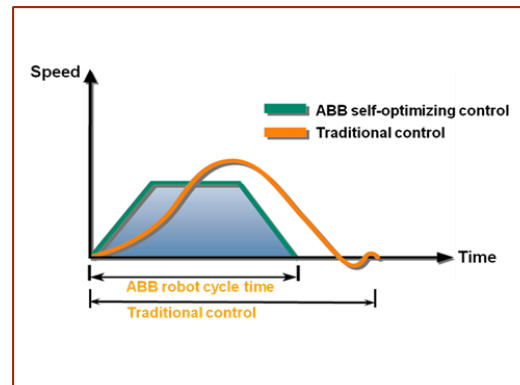
- 1st. Iteration: 0.18mm mean/max dev.
- 2nd. Iteration: 0.16mm mean/max dev.

World best motion control

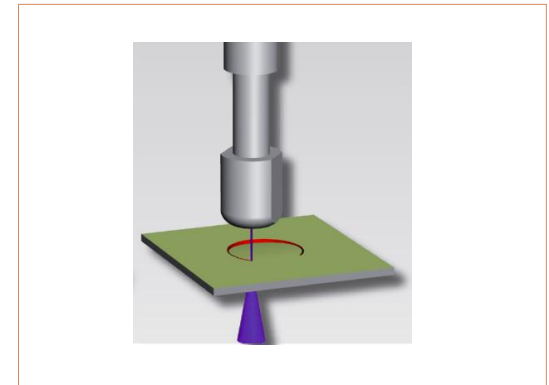
Standard ABB motion features



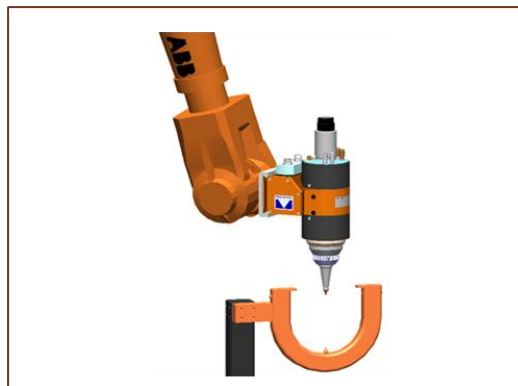
TrueMove



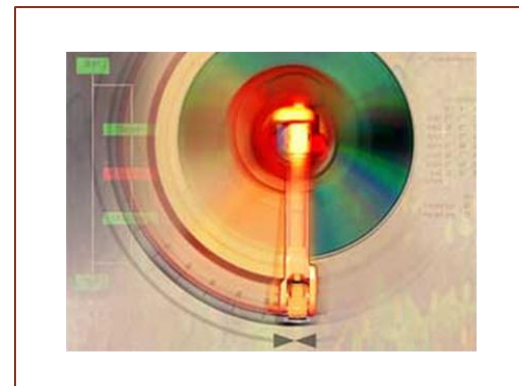
QuickMove



WristMove



BullsEye



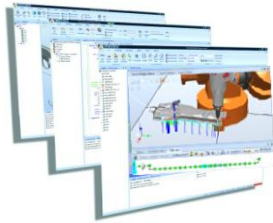
AbsoluteAccuracy

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



RobotStudio Cutting PP



RobotWare Cutting

Power and productivity
for a better world™

