WISEWELDING

# Machine vision system for adaptive robotic welding


## Product datasheet

By Wise Technologies Ltd.

# INTRODUCTION

In welding production geometries of consecutive parts vary to some extent. Consequently actual seam positions have to be determined during robotic welding.

This can be done manually by the robot's tool point and operator's subjective judgement. Manual adaptation is slow, tedious and subject to human errors.

Automatic sensing of various seam topologies is best achieved with Wise WELDING machine vision system. Wise WELDING imaging module is mounted on a robot arm and detects actual seam position. Position is sent to the robot by Wise WELDING processing unit. Robot uses it to adapt welding torch position accordingly. Such correction is accurate, precise, reliable and considerably faster compared to manual operation.

# OVERVIEW

Following is an overview of *main features* and *components* for Wise WELDING system.

## Main Features

| **Wise WELDING features:** |
|---|
| **Automatic welding path adaptation to geometry deviations in series production** |
| **Up to 10x throughput gain compared to manual adaptation.** |
| **All-in-one vision module for large geometry displacements, precision guidance with range of welding technologies** |
| **Enables sensing for gapless[1] butt seams without mismatch** |
| **Detects seams of materials with different reflection/finish** |
| **Conforms to all standard seam topologies, special topologies can be added** |
| **Robust algorithms on any surface: black metal, stainless steel, mate or brushed, damaged, scratched** |
| **Consecutive (seam finding) or simultaneous sensing (seam tracking) with welding to accommodate any production strategy** |
| **Tailored to meet best price-performance in terms of speed, precision, working range, space constraints** |
| **Rapid SINGLE teaching to new type of work piece geometry for flexibility, maximized equipment exploitation and return of investment** |
| **Industrial class protection against arc flash, heat transfer, high frequency electromagnetic interference (e.g. from TIG/GTAW sources)** |
| **Seamless integration into robotic platform with complete parameterization and operation performed via robots teach pendant only** |
| **Easy connectivity, setup and calibration** |
| **Customizable solution to meet specific needs** |
| **Superior service and support with hands-on user training on particular user application** |

## Components overview

Main components of Wise WELDING system are shown in Table 1.

| # | component | description |
|---|---|---|
| 1 | imaging module, mounting adaptor | mounted on a robot arm, connected to the processing unit with flexible cabling |
| 2 | processing cabinet with display in industrial enclosure, cabling | processing unit inside industrial cabinet, electronics, user display on adjustable holder, signal and protocol cable connection, communication to robotic controller |
| 3 | Wise WELDING application | software program for image acquisition & analysis, seam position calculation, communication with the robot, process visualization |
| 4 | documentation | users manual, wiring diagram, safety operation manual, list of spare parts |

Table 1: components of Wise WELDING system

# COMPONENTS

Offers detailed description of Wise WELDING components.

## Imaging module

Module is normally mounted on the robot arm and images the seam in front of the torch. Typical Wise WELDING imaging module properties are shown in Table 2. They can be customized to properly assert specific project requirements.

| property | value |
|---|---|
| **geometry deviation of consecutive parts (mm)** | ±10 |
| **minimum butt-seam gap (mm)** | 0,05 |
| **accuracy and precision (mm)** | 0,1 |
| **mass (kg)** | 1 |
| **mean working distance (mm)** | 100 |

Table 2: standard Wise WELDING module properties

Standard Wise WELDING imaging module dimensions are shown in Image 1.

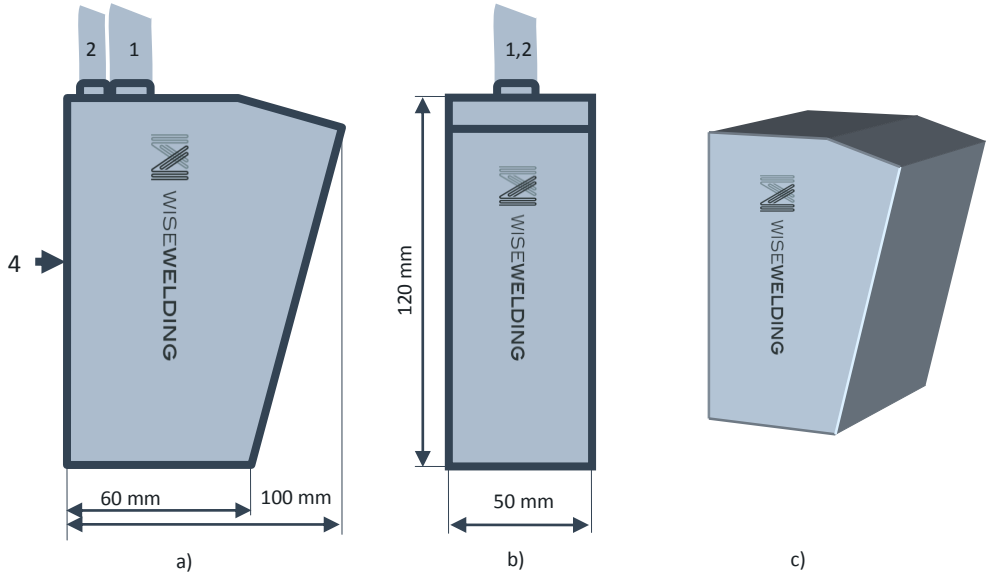


Image 1: standard Wise WELDING module dimensions: a) side view, b) front view, c) 3D view; 1 cabling, 2 cooling media connection, 3 module body, and 4 robot mounting spot

Image 2 is showing Wise WELDING module in production.

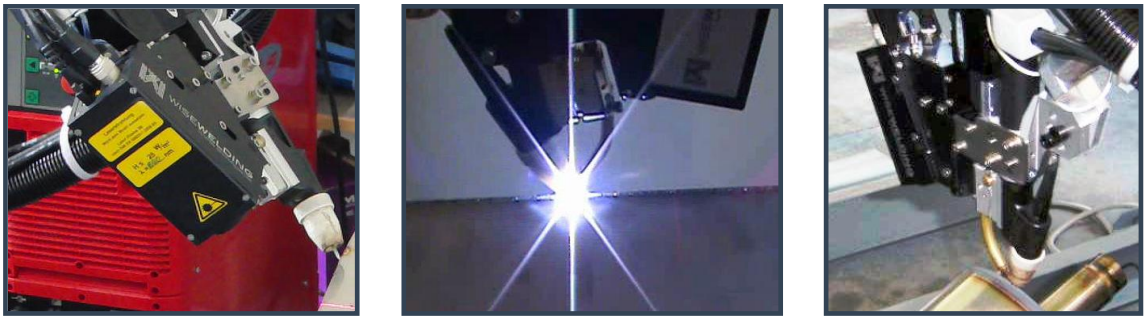

Image 2: Wise WELDING in production

Imaging is unsusceptible to arc flashing, high frequency electromagnetic interference, heat transfer, material spraying and vibrations. Cooling media (air, water) can be attached to the module as necessary. Its required capacity is normally provided by the end user. Module can be used for MIG/MAG, TIG/GTAW, plasma, laser welding etc.

## Processing cabinet

Processing cabinet is comprised of industrial cabinet, processing unit, interface electronics and user screen on flexible adapter. It hosts Wise WELDING application. Cabinet dimensional drawing is shown in Image 3.

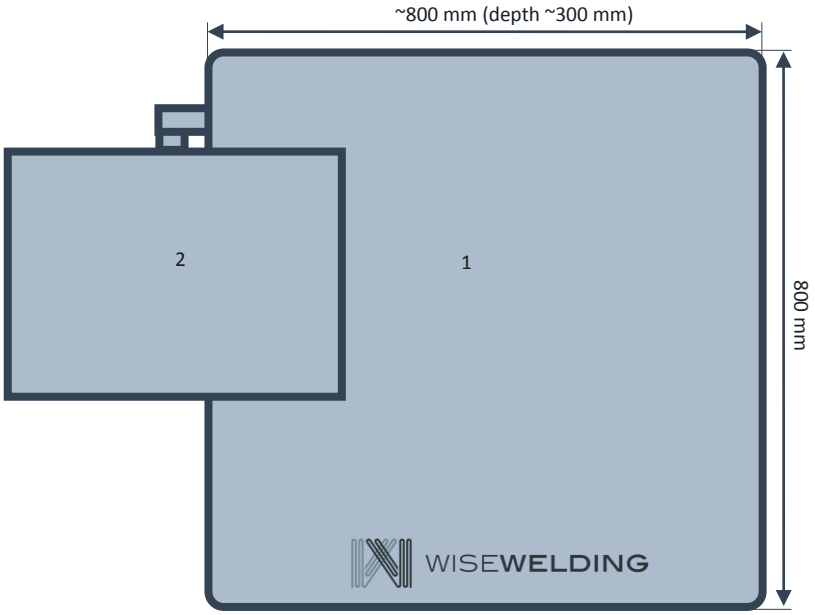


Image 3: processing cabinet: 1 industrial enclosure, 2 user screen with flexible arm

## Wise WELDING application

Wise WELDING application is acquiring the seam position from imaging module and communicates with the robot. Imaging conditions and application status are displayed on user screen. It implements searching and tracking of the following standard seam topologies: corner, overlapping, butt seam as shown on Image 4. Custom seam topologies can easily be added.

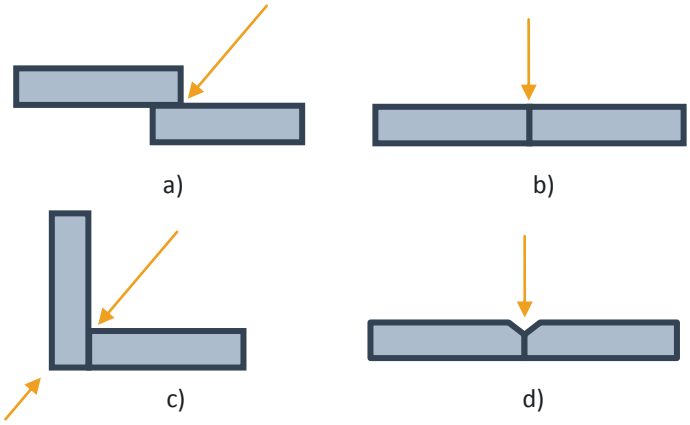


Image 4: standard seam topologies: a) overlapping, b) butt, c) corner, d) V/Y/X-shaped butt seam; arrow denotes direction of imaging

Operation on various materials (black metal, stainless steel ...) with different finish (mate, brushed, polished ... up to 90% remission) is ensured. Sensing of closed[1] butt seam with no mismatch is possible. Seams of two materials with different finish/reflection can be detected. Tracking is largely unsusceptible to surface scratches, irregularities, varying ambient conditions.

Commonly no direct interaction with Wise WELDING system is needed by a robot operator. Complete parameterization is done via robot's programming interface. User can rely on visual feedback from Wise WELDING application user screen for optimal imaging of master geometry during teaching and advanced diagnostics in production.

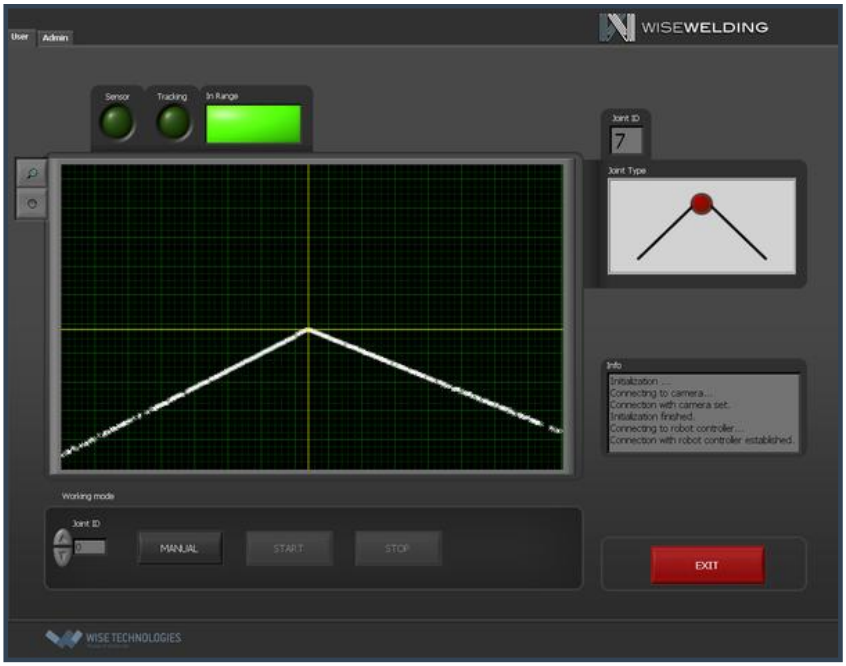


Image 5 user interface of Wise WELDING application

# INTEGRATION

System integration usually includes delivery of Wise WELDING components, equipment connection, and system functionality test of communication with the robot and tracking of sample standard seams. Finding optimal workflow with adaptive robotic welding cell (Wise WELDING, robot, welding source, part clamping, part positioning ...) on particular end user part is subject to quality consulting, project preparation and execution, training and support.

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## Workflow

Typical workflow with Wise WELDING system consists of two steps:

Step 1: teaching "master" geometry of the part

Teaching of master geometry begins by its splitting into arbitrary number of welding paths based on customer's expertise. Path points are then sensed at strategic seam positions using Wise WELDING. Each path is assigned a "seam type" and complete process is done **once only** using robot's teach pendant. Alternatively offline robot programming software can be used to teach master geometry.

Step 2: automatic path adaptation of welding paths for consecutive parts

Geometry of next part deviates from master geometry typically due to tolerances of comprising parts, their put-together, clamping tolerances and thermal deformations during welding. Robot starts moving along the master path waiting for Wise WELDING to detect the seam start. Once found robot motion shifts to adapted path for proper welding. Wise WELDING is continuously guiding the robot along the welding path length. The process is repeated on all welding paths and complete part is welded automatically.

## Training and support

Proper and thorough training is of paramount importance for successful welding application. Normally hands-on training with real equipment and customer's target work piece is most beneficial. It is a preferred method of knowledge transfer for optimal results and highest customer satisfaction. Training scope is best determined upon project definition.

# CONTACT

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[1] minimal gap of butt seam without mismatch is determined by "minimum butt-seam gap" in Table 2