Motosight 2D for weldling

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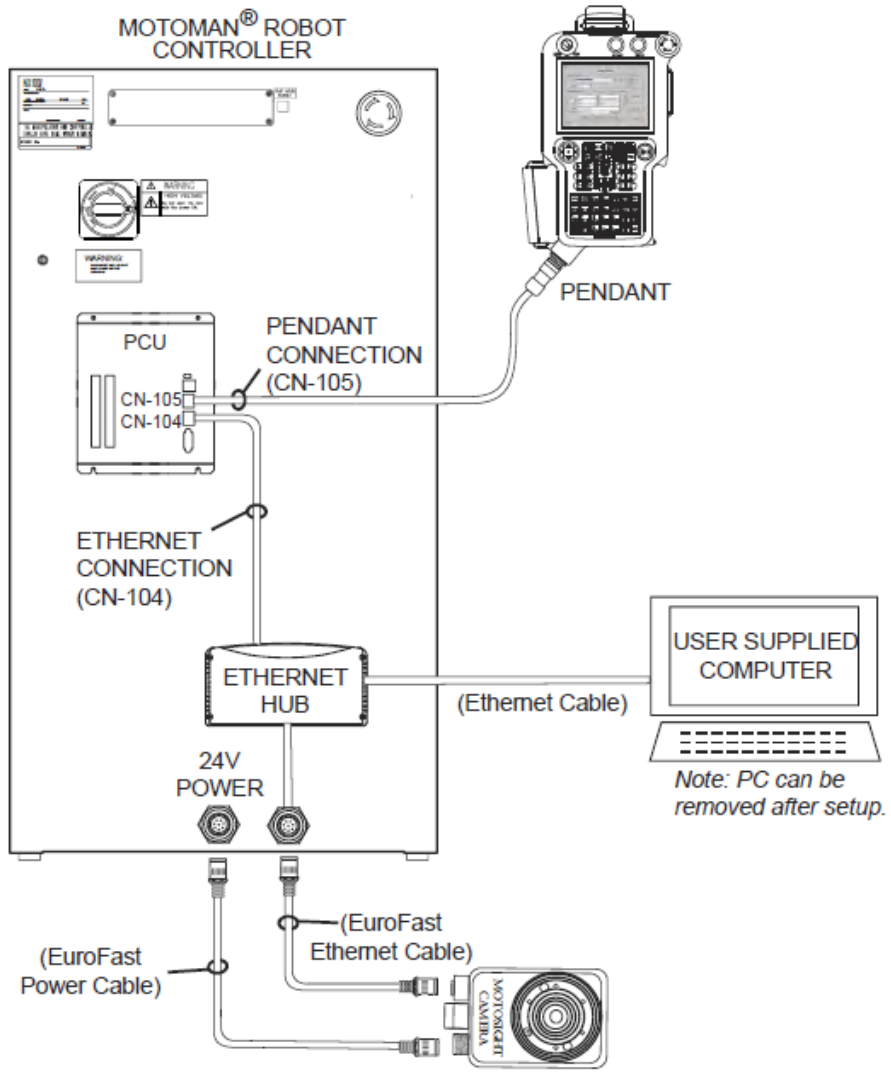
YASKAWA ELECTRIC CORPORATION

Motosight 2D for welding

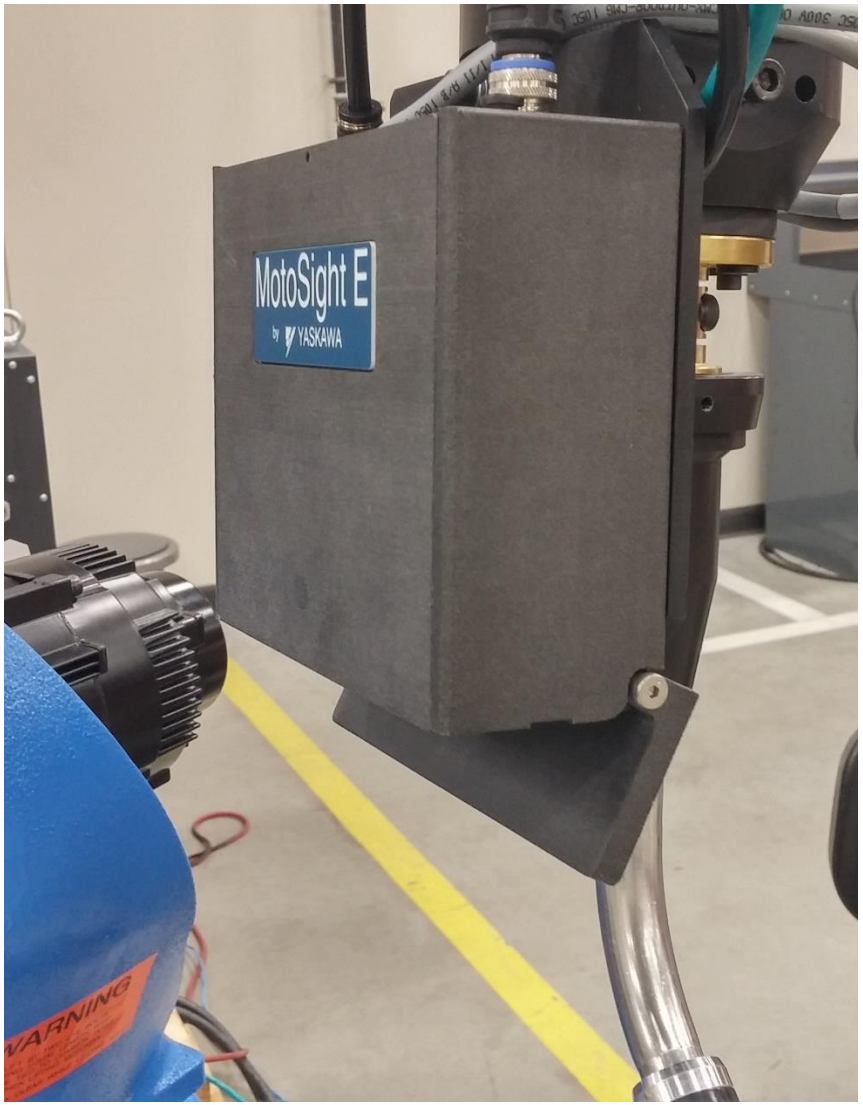
- Can be used to detect lateral weld joint movement
- For certain applications, it can also be used to measure weld line rotation
- Does not detect depth (distance from camera)
- Very quick measurement time (in general, fastest of all sensing technologies)

Motsight 2D for welding: Config

- Preparation
  - Review "Motosight 2D Global Edition" manual
  - Procure the work instruction SSGW-429
- Hardware
  - Mount camera. Arrange for lighting (if needed). Consider provisions for protection from weld environment
  - Ensure all connections are made
    - Power + Ethernet / POE to sensor, Ethernet to controller, Ethernet to PC
    - Install In-Sight Explorer to PC
  - Install required camera lens for application



Motosight 2D for welding; Example of Sensor Mounting



Motosight 2D for welding: Setup Sequence of Operations

1. Configuration for: Robot <-> Sensor communication
2. Calibrate sensor for the working distance / stand-off distance
3. Program to application
    1. Move Sensor to weld path to be measured, then move to stand-off distance.
    2. Adjust sensor settings for application
    3. Program macro instructions into robot job
    4. Deploy shift amounts(s) and program weld path

Motosight 2D for welding: Robot <-> Sensor Communication

- Set IP address of robot port in the MS2D app
  - On robot PP, open the Pendant Application for Motosight2D (MAIN MENU > APPLICATION > “MS2D *.*.*”
  - Set the IP address used for the DX controller LAN port (which was configured during MS2D Work Instruction setup) into the “Robot IP Address” field

- Now that the sensor is connected to PC, lets Calibrate! …

Motosight 2D for welding: Calibration Overview

- Calibrate the sensor to the robot based on the camera's distance-to-weld seam (If using multiple camera stand-off distances, repeat the following three (3) steps)
- Overview – Calibrating sensor to robot
  1. Teach User Frame to Calibration Grid/Sheet

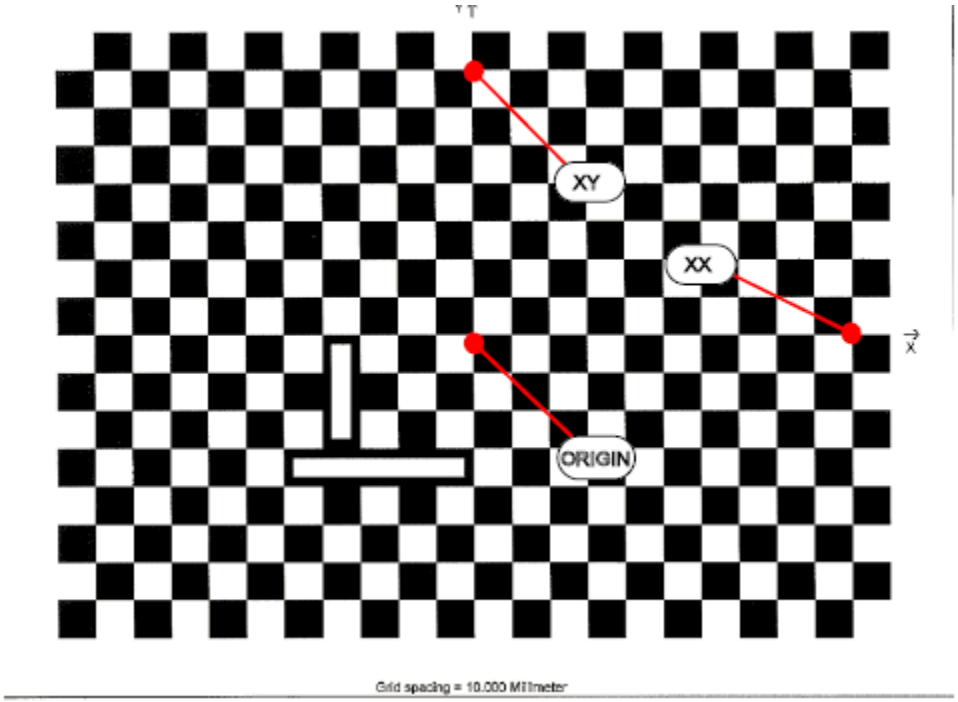
     Used to attach (orientation) camera measurement to the robot's coordinate system
  2. Move sensor to required height above Calibration Grid. Adjust Focus / Exposure.

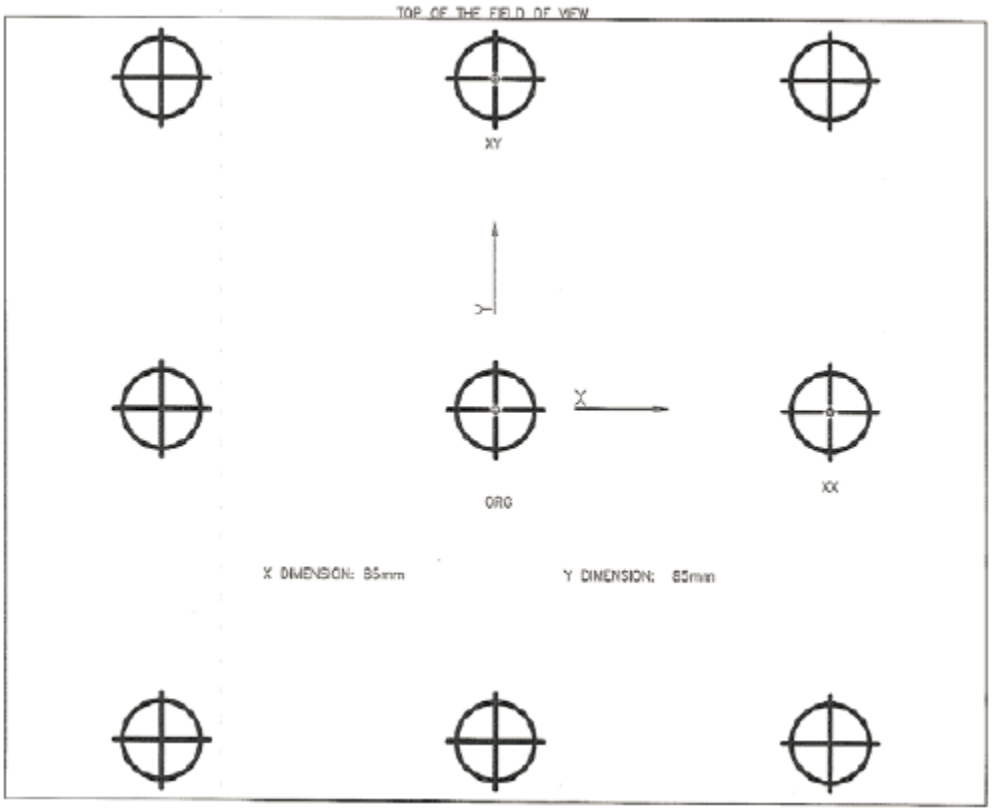
     Used to scale (1mm in camera = 1mm in robot's frame) the camera measurement to the robot's frame, based on the programmed camera-to-grid distance
  3. Run the TOOL job

     Creates a Tool Center Point / Frame. This TCP will be used during weld joint measurement routines to utilize the camera orientation and scaling calculations made above

Motosight 2D for welding: Calibration

1. With a good TCP of the welding torch, teach a User Frame to a printed calibration sheet (use either “9-point target” or “calibration grid” method)

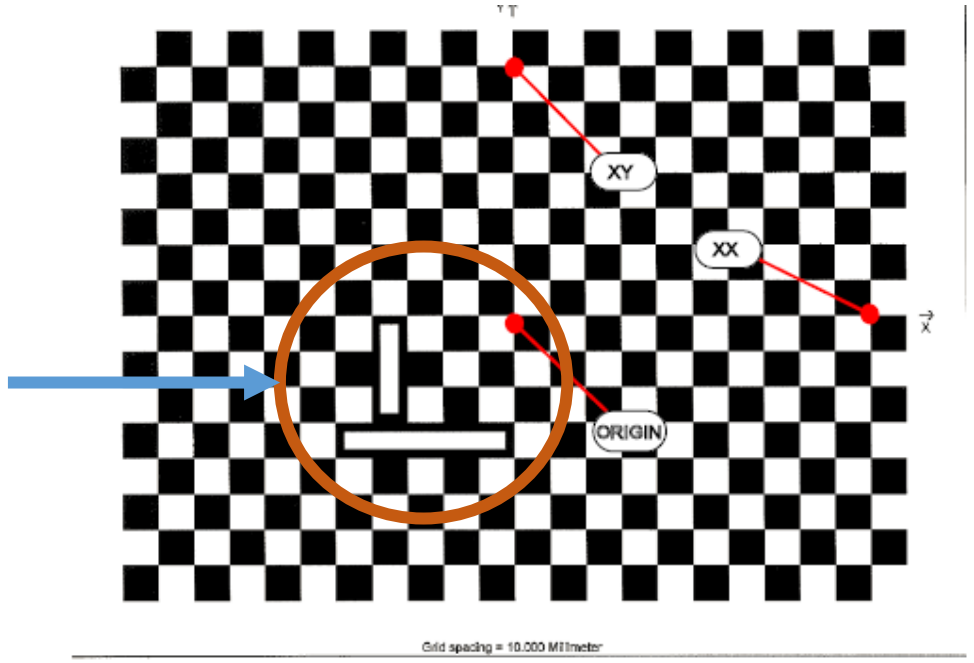




- NOTE: Grid-with-fiducial Calibration: offers adjustable grid size for small camera field of view. Also adjusts for lens distortion

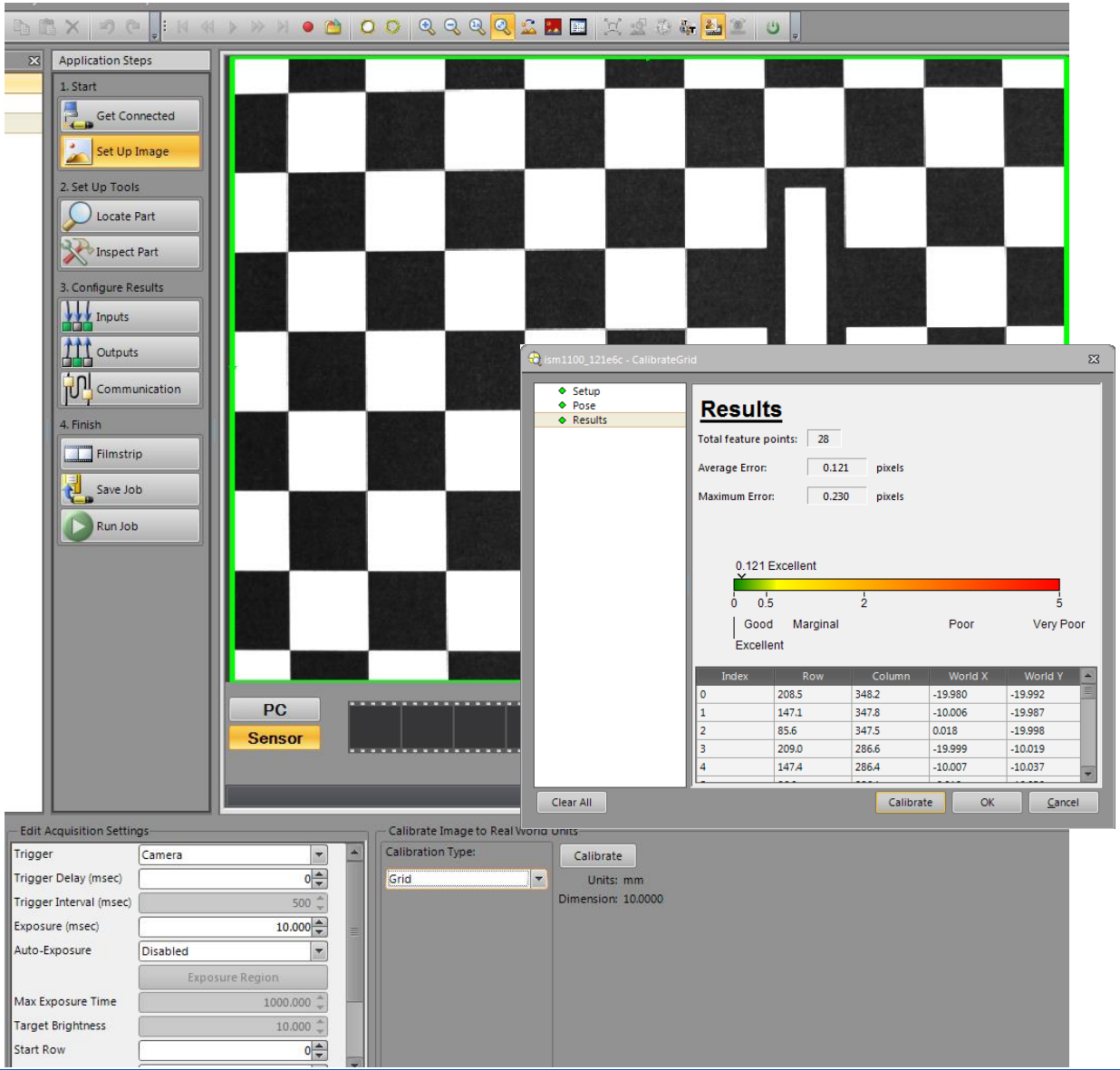
Motosight 2D for welding: Calibration

2. Next, **move sensor** to required height above grid, making sure entire center element is visible (note “IMOV method” discussed later).



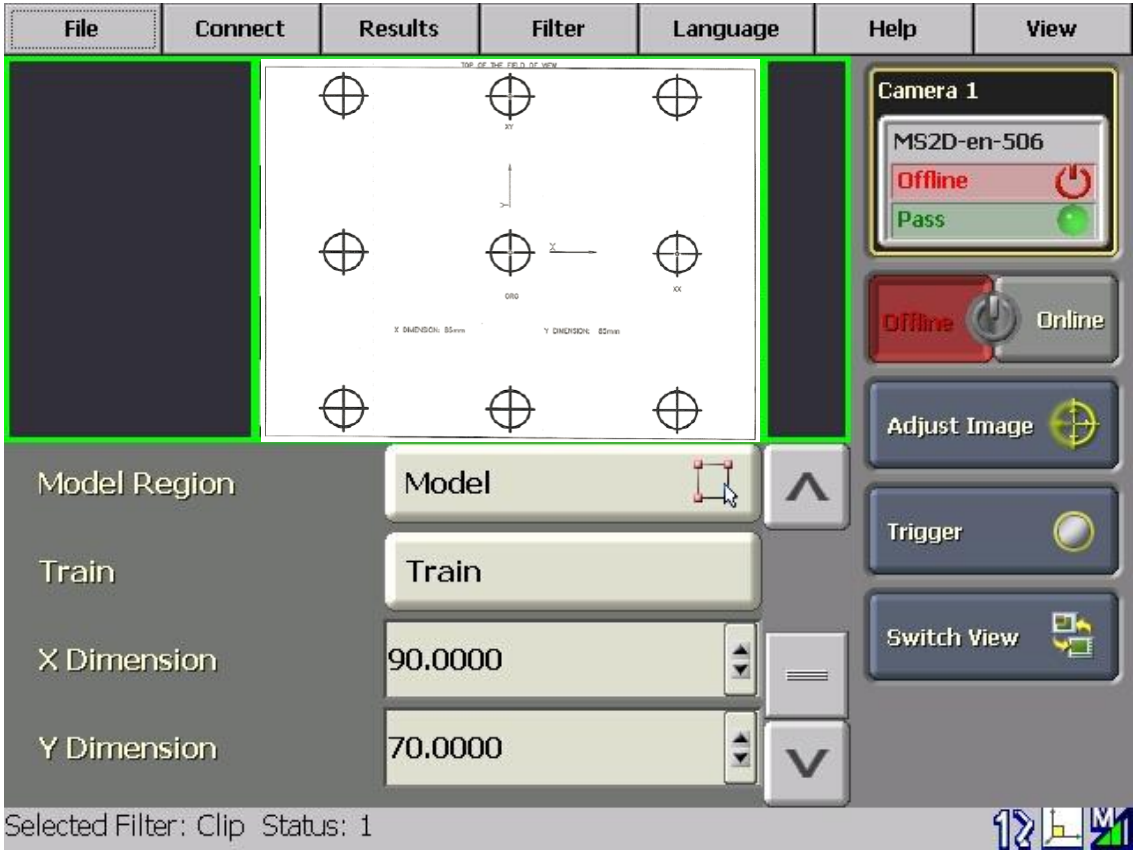
Motosight 2D for welding: Calibration

- Run “CalibrateGrid” in In-Sight Explorer.
  - Note: With calibration grid method, adjust grid size so at least the entire center element (the fiducial) fits into field of view
  - Note: pixel size of the sensor is now calibrated to an actual distance in mm.



Motosight 2D for welding: Calibration

- As an alternative to using the In-Sight Explorer calibration method, you may instead use the Easy Builder programming pendant application.
  - Easy Builder Calibration: requires used of 9-Point Target
  - Model: place box around middle circle
  - X/Y dimensions: distance between sides of rectangle defined by outer circles

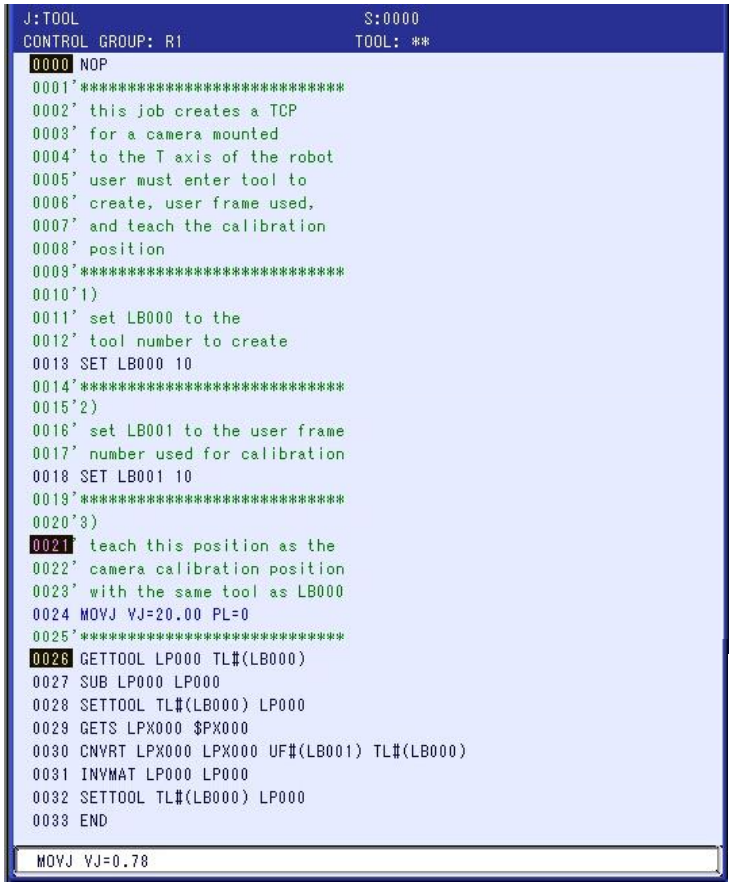


Motosight 2D for welding: Calibration

3. Third, **run the TOOL job**, setting the required UF# that was used on the calibration grid and also set the Tool File# you'd like to have the TOOL job create.

   Note: the measurement distances of the Cognex camera are now tied to robot coordinate systems via the Tool File# that was just created.

   As the sensor is used on different weld seams across the weldment, this same Tool File is used to apply the newly-measured Cognex weld joint location onto robot Base Frame / User Frame coordinate systems

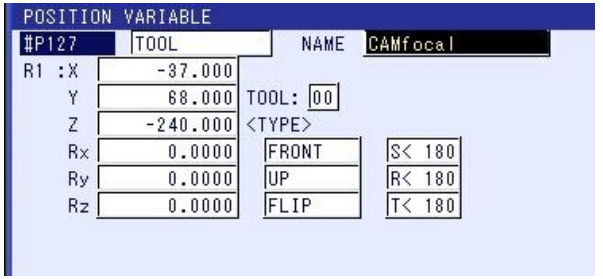


Motosight 2D for welding: Stand-off Distance

- Setting for Stand-Off Distance
  - Configure for the camera's "distance-to-weld seam." For robot-mounted Cognex cameras, for each weld seam the robot needs to position the camera to a certain stand-off distance from the weld seam. This distance should be the same distance used during the previous step's calibration. Two methods exist: (1) User Frame Method and (2) M2D-SFT macro job
    - UF method:
      1. teach a User Frame "A" onto the weld seam to be detected. Use either the 3-point method (manually teaching these points) or Calculated 3-point method (MFRAME instruction)
      2. Move the robot's TCP to User Frame Origin (0,0,0) using the Tool File# taught previously (when the TOOL Job was executed)
      3. Repeat for each location of the weld seam you need to measure.

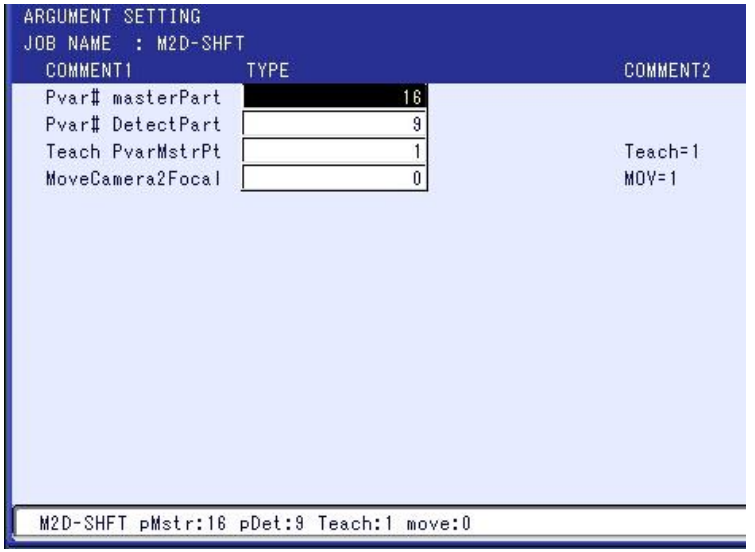
Motosight 2D for welding

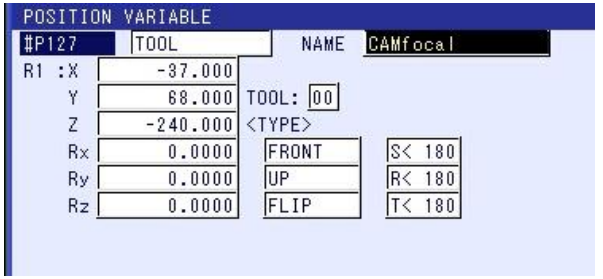
- Setting for Stand-Off Distance
  - M2D-SHFT macro job method:
    - Manually configure a P Variable (ie. P127) for proper camera height. (i.e. -120mm in Z of Tool Frame using Tool # x).
      - Create a P Variable based on TOOL Coordinates. Reference the TOOL FILE number used previously for calibration.
      - Set X, Y, and Z amounts
        1. Move torch TCP to center of grid
        2. Execute IMOV P*** TF V=***
        3. Robot should move camera to stand-off distance from grid and roughly over the center of the grid



Motosight 2D for welding

- Setting for Stand-Off Distance
  - M2D-SHFT macro job method [con't]:
    - Reference this P Variable number in the M2D-SFT macro job's "SETUP" section.
    - Create your temporary / test Job, insert M2D-SFT macro instruction, and set "MoveCamera2Focal" argument to a value of 1.
    - Move the end of welding wire / torch TCP to center of grid. INT LOCK + TEST START this macro instruction and observe the camera moves to the needed height / location above grid



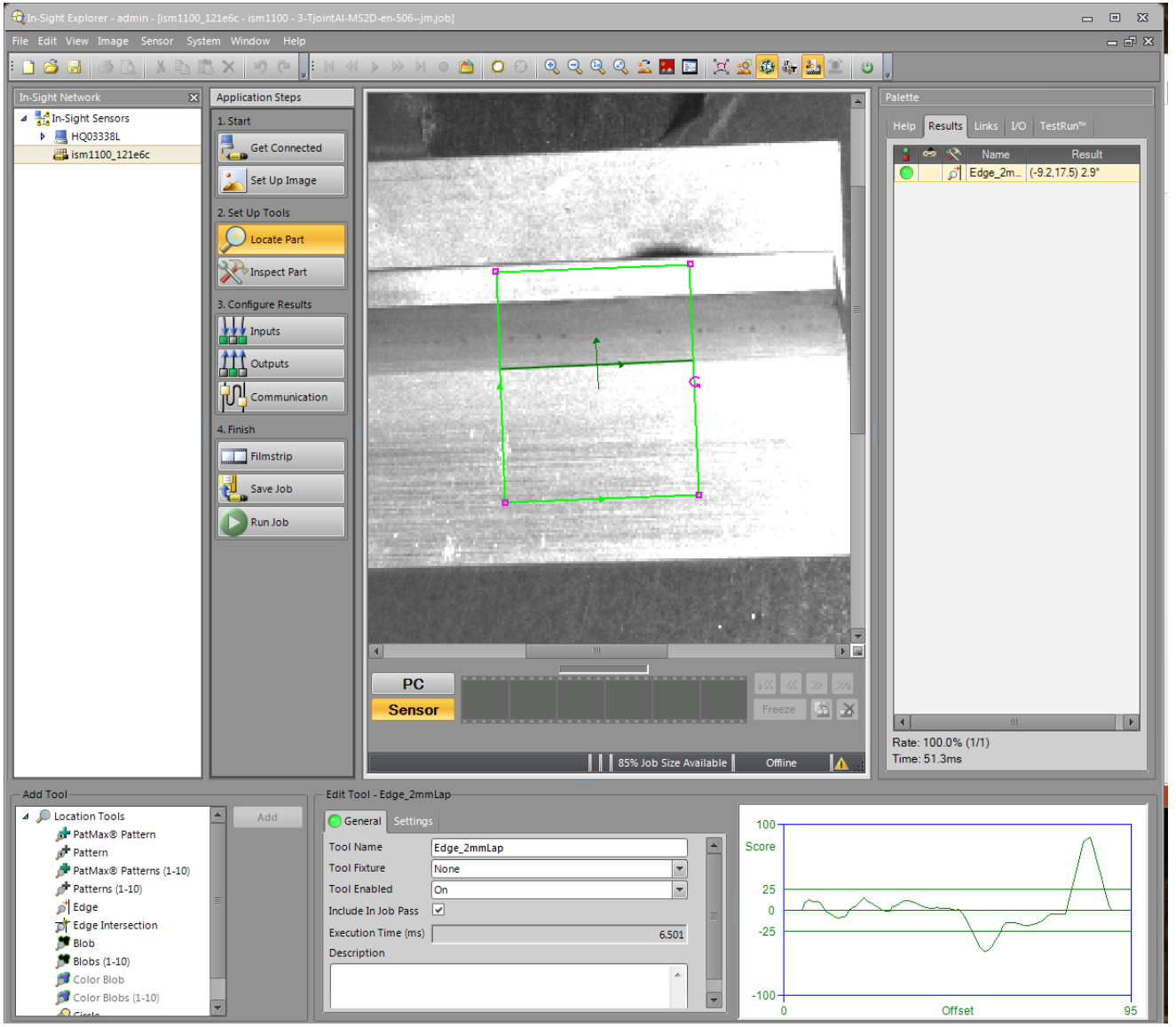


Motosight 2D for welding

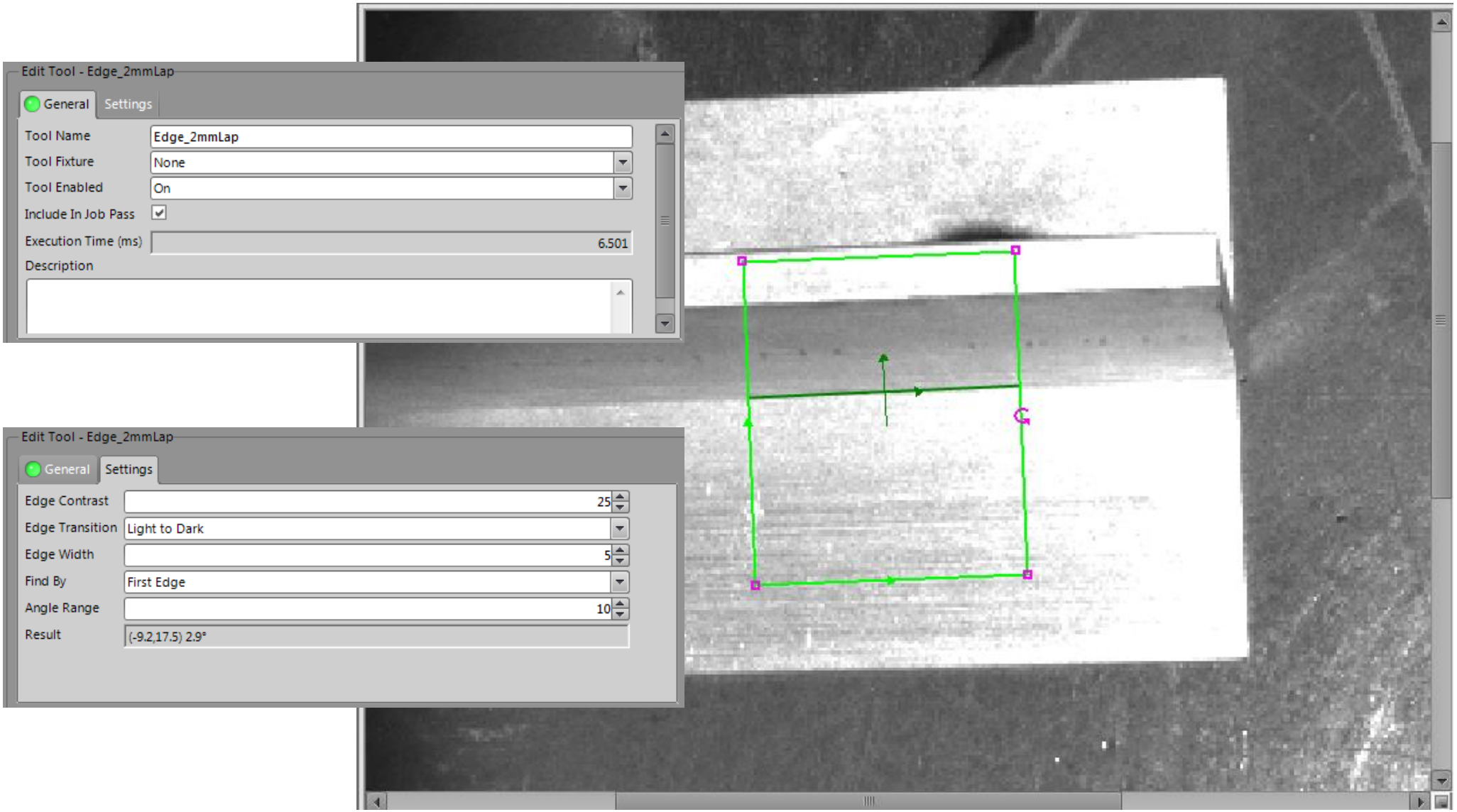
- Now to Program the Application! …
- Open the robot Job to be used for detecting the weld seam location. Move camera over weld seam (using UF or M2D-SHFT).
- From In-sight Explorer
  - **Make an In-Sight Explorer "JOB"** from on an existing JOB. Note: do not create a new job; rather, copy and change from an existing MS2D template.
  - **Add a Tool(s)** to detect weld seam / part geometry. Adjust lighting / lighting angle (robot position) / exposure. Set size of inspection Tool based on expected part movement. Finally, set sensor to ONLINE and then LOG OFF from PC.
    - For most applications, EDGE Tool is satisfactory for welding applications. EDGE is convenient because it is portable (one Cognex Job / 1 Tool can be used for multiple weld joint locations).
    - Ensure the EDGE tool is perpendicular to the edge of the weld seam
    - PatMax may be able to be used for smaller welds
  - If you take care with Cognex settings (Tool size, location, lighting/exposure, etc.), you may be able to use the same Cognex job for multiple weld seam measurements (ie. 10 measurements along a 10' long weld seam might all be able to use the same Cognex Job)

Motosight 2D for Welding

- In-Sight Explorer
  - Tool added via “Locate Part” > “Edge” tool
  - Adjust for “transition”, “contrast”, and “find by” settings
- If poor image stability is observed due to poor contrast, adjust ambient lighting / add external light source
- When completed with sensor and Tool settings, Exit Insight-Explorer.

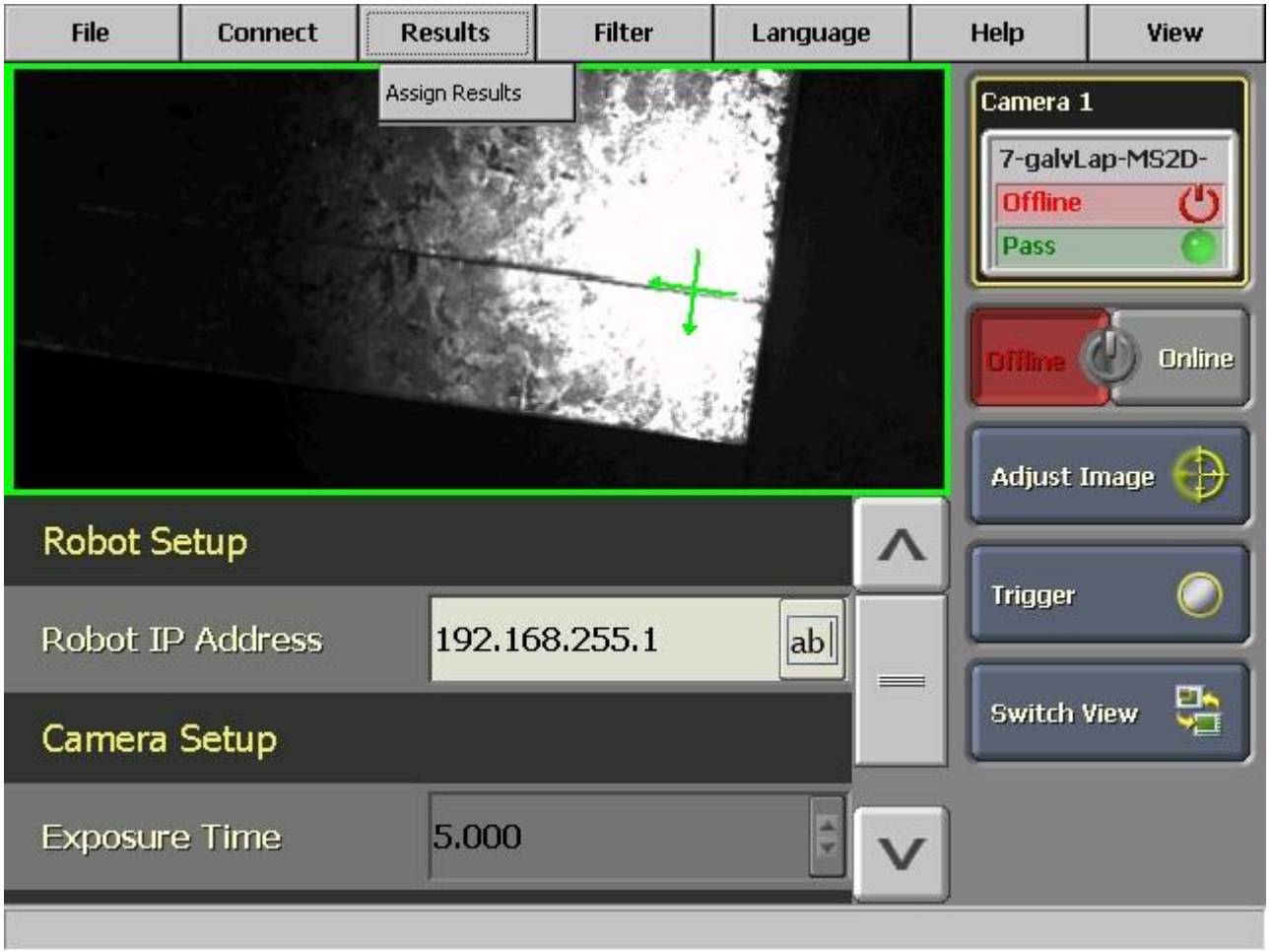


Motosight 2D for Welding



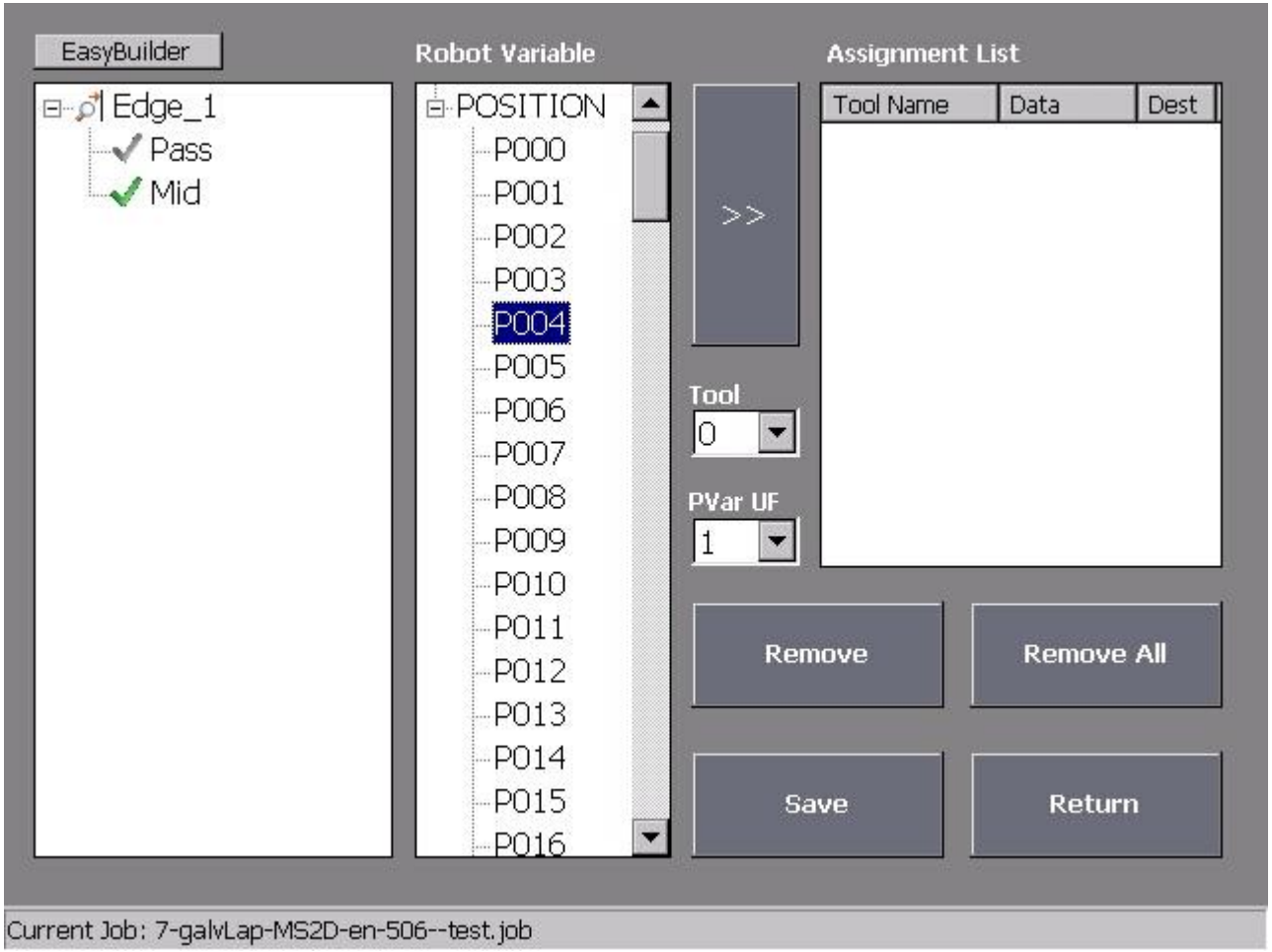
Motosight 2D for welding

- Next, on the DX controller, open the PP Application for EASY BUILDER.



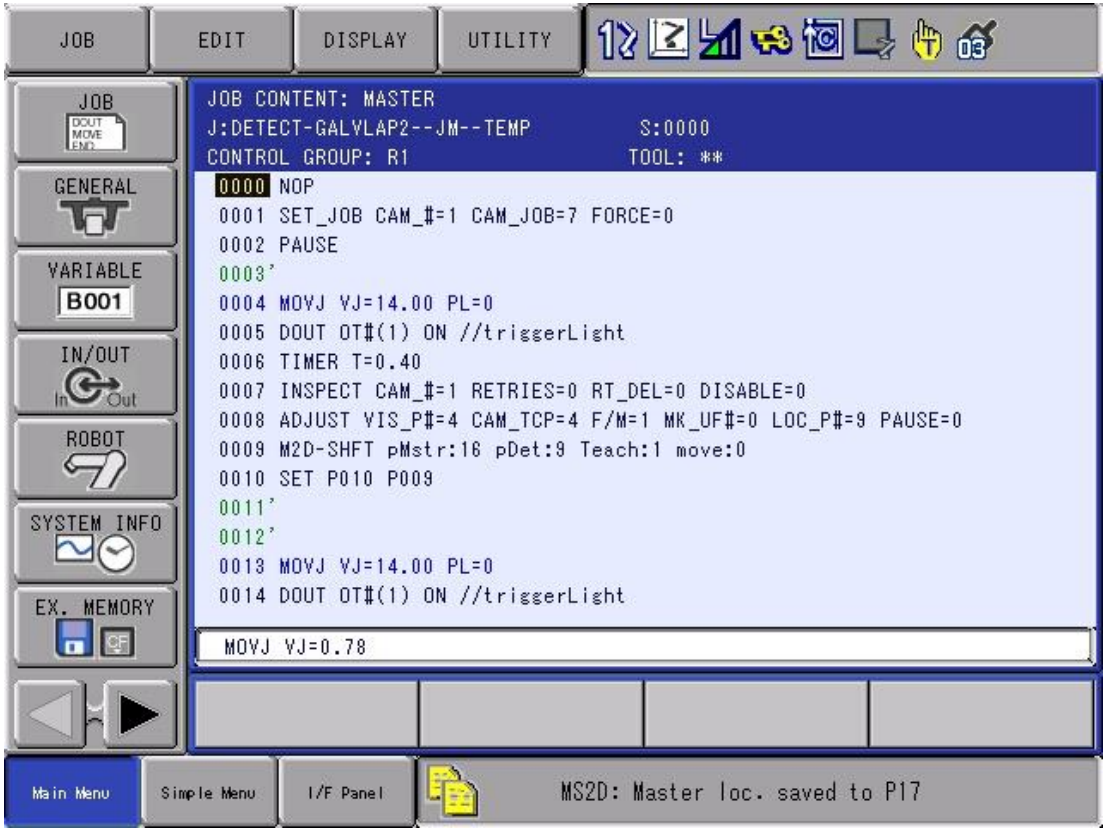
Motosight 2D for welding

- Assign variable(s) to inspection Tool(s) created previously.



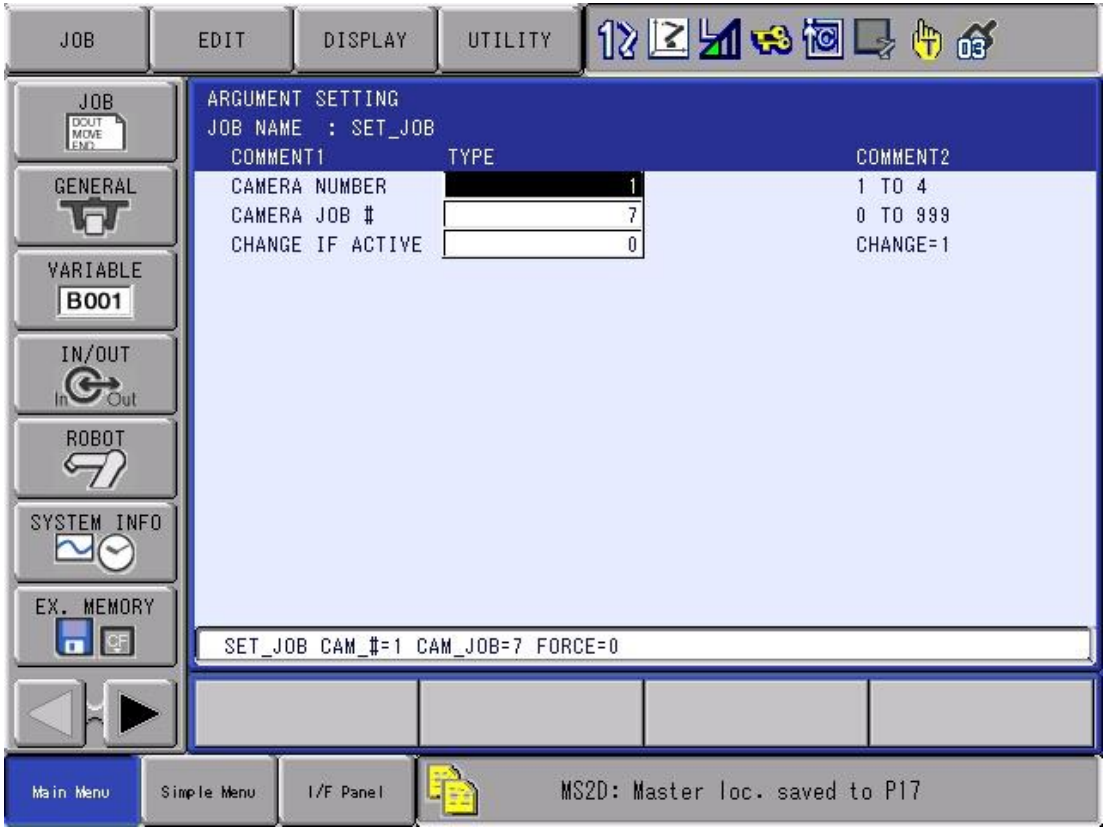
Motosight 2D for welding

- Add INFORM commands to process this inspection
  - SET_JOB
  - INSPECT
  - ADJUST
  - M2D-SHFT (Not part of the Motosight 2D standard macro jobs)



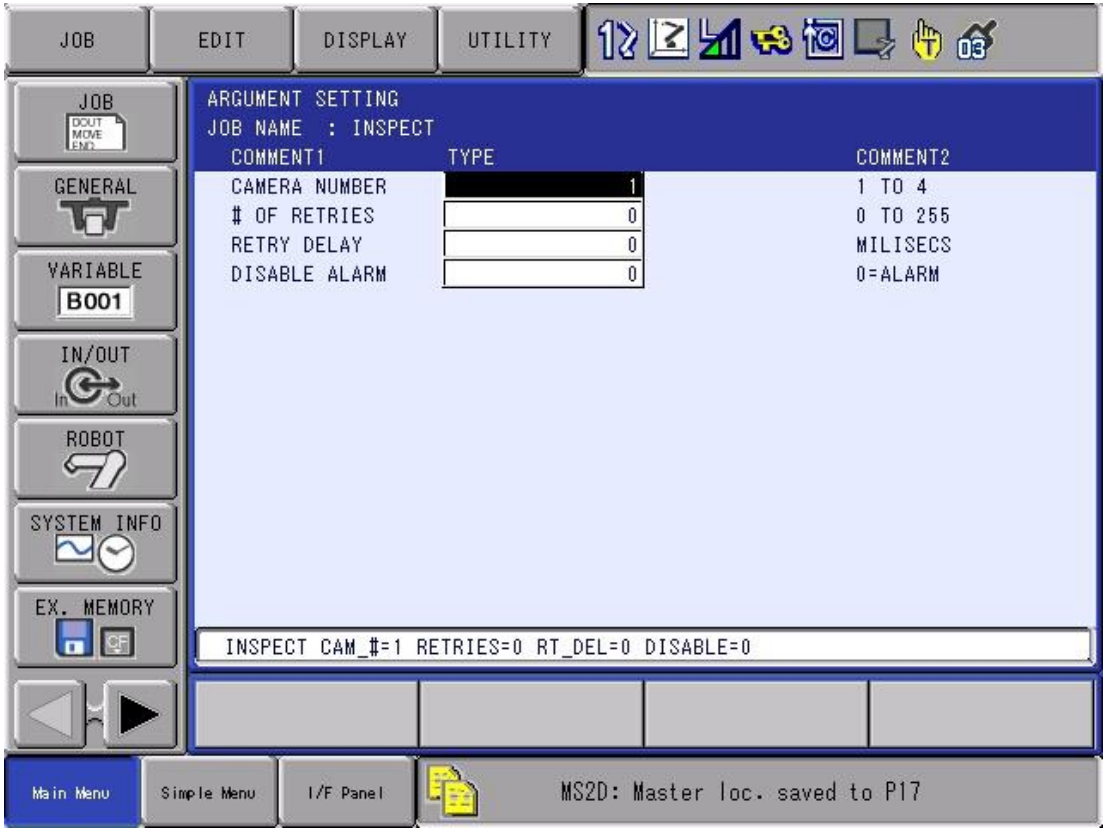
Motosight 2D for welding

- SET_JOB macro
  - Opens a job in the Cognex camera. To be called by this macro, the Job name in the camera must begin with a number, and the CAM_JOB argument references this number.



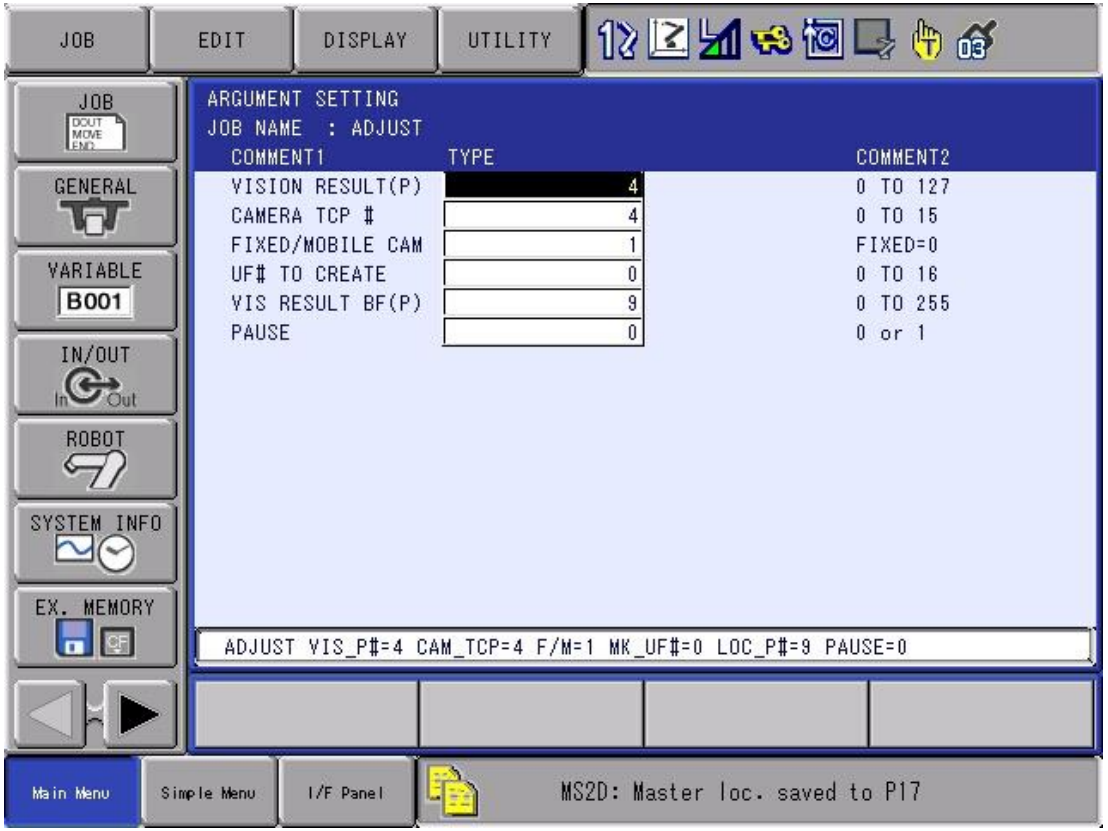
Motosight 2D for welding

- INSPECT macro
  - allows the Cognex camera to Trigger the measurement
  - handles system errors related to this measurement
  - Configure Re-Try sequences



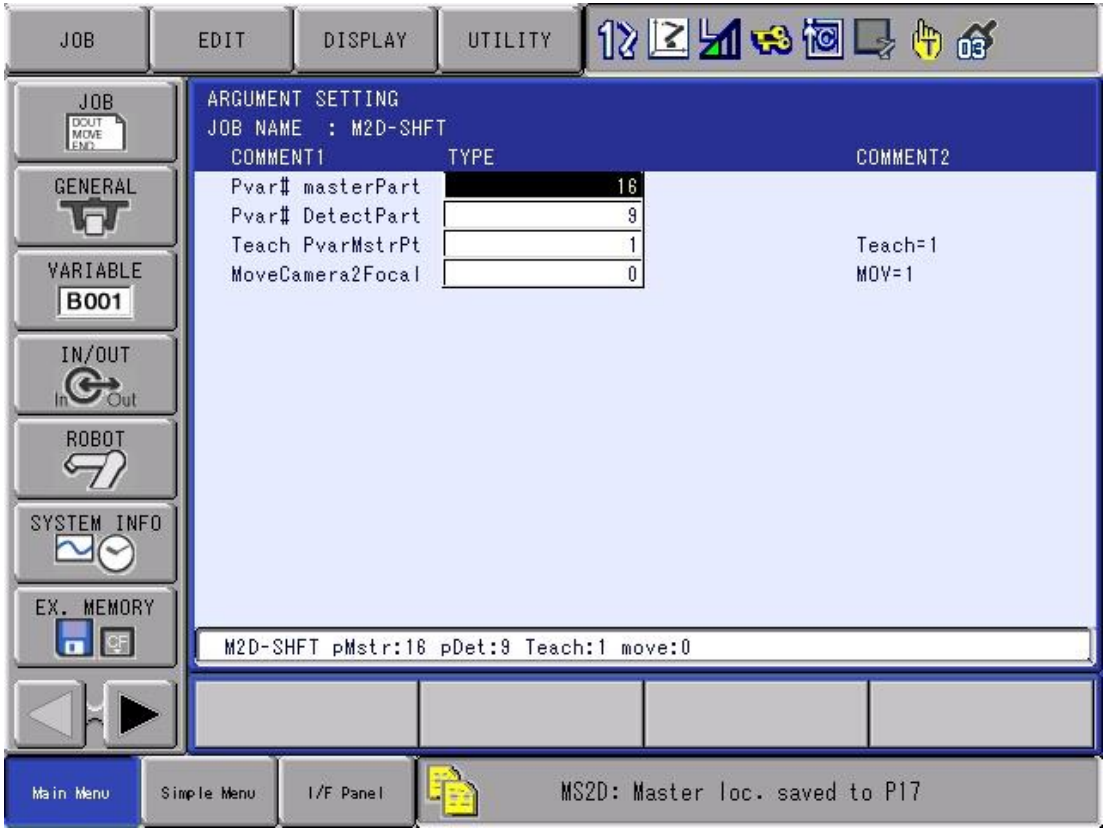
Motosight 2D for welding

- ADJUST macro
  - Configures how the measurement data is configured (which User Frame) and the destination P variable #
  - Saves the measurement location to a 2nd P variable in Base Frame (useful for weld path shifting)



Motosight 2D for welding

- M2D-SHFT macro
  - Developed for conceptual purposes (not a standard macro job with MS2D)
  - Stores master part location into P var “masterPart” (this is done during teaching)
  - During playback, it compares location of “DetectPart” P var to “masterPart”, and then calculates a shift amount
  - The “MoveCamera2Focal” argument is used to place camera at proper height over weld seam



Motosight 2D for welding

- Robot Job structure:
  - INSPECT + ADJUST + M2D-SHFT = shift amount
  - Use SFTON instruction as you would with other sensing technologies.

```
0001 SET_JOB CAM_#=1 CAM_JOB=7 FORCE=0
0002 PAUSE
0003'
0004 MOVJ VJ=14.00 PL=0
0005 DOUT OT#(1) ON //triggerLight
0006 TIMER T=0.40
0007 INSPECT CAM_#=1 RETRIES=0 RT_DEL=0 DISABLE=0
0008 ADJUST VIS_P#=4 CAM_TCP=4 F/M=1 MK_UF#=0 LOC_P#=9 PAUSE=0
0009 M2D-SHFT pMstr:16 pDet:9 Teach:1 move:0
0010 SET P010 P009
0011'
0012'
0013 MOVJ VJ=14.00 PL=0
0014 DOUT OT#(1) ON //triggerLight
0015 INSPECT CAM_#=1 RETRIES=0 RT_DEL=0 DISABLE=0
0016 DOUT OT#(1) OFF //triggerLight
0017 ADJUST VIS_P#=4 CAM_TCP=4 F/M=1 MK_UF#=0 LOC_P#=9 PAUSE=0
0018 M2D-SHFT pMstr:17 pDet:9 Teach:0 move:0
0019 SET P011 P009
0020
0021'
0022 MOVJ VJ=14.00
0023 SFTON P010
0024 MOVL V=222.0
0025 TIMER T=0.20
0026 SFTON P011
0027 MOVL V=60.0
0028 TIMER T=0.20
0029 SFTOF
0030 MOVJ VJ=4.00
0031 END
```

Motosight 2D for welding

- Closing notes
  - Cognex Tools are available for measuring distances between two objects (ie. two edges). This could be useful for Adaptive Welding where Gap measurement can lead to weld parameter changes.