The YSU Excellence Training Center Automated Foundry/Post Processing Lab

Excellence Training Center

Project Organization

Defense Logistics Agency

National Center for Defense Manufacturing and Machining (NCDMM)

University of Northern Iowa

Youngstown State University

YSU Excellence Training Center

Youngstown Business Incubator

Humtown Products

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Project Objective

To strengthen the domestic defense/DLA manufacturing supply chain

- Demonstrating industry 4.0 technologies at the Excellence Training Center (ETC)
  - Building a foundry of the future and post processing lab
  - Performing additive metal research/using 3D printed sand molds in foundry
- Assisting small to medium entities implement industry 4.0 technologies
  - Providing informational webinars
  - Providing workforce training at the ETC
  - Providing business case analysis

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Industry 4.0 Technologies

- Robotics, Automation (Programmable Logic Controllers (PLCs)
- IT infrastructure (digital twin/digital thread)
- Embedded Sensor Technologies
- Additive Manufacturing
  - 3D printing hard and soft tooling
  - 3D printing sand molds
  - 3D printing metal research

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Automated Foundry

Post Processing

Goal:

Develop a methodology to increase the flexibility of robotic systems to remove casting features with 3D vision that can be implemented by SMEs in the DLA supply chain.

- Minimize hard tooling and fixtures
- Increase robot cell flexibility
- Reduce programming requirements

Equipment:

- Standard robot – Fanuc M900iB
- Vision System – Fanuc iRVision
- Tooling/Fixtures – COTS components
- Sensors – COTS sensors (ex: Dialog IoT)

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Post Processing

Reducing programming complexity

Principles and methods exist to greatly reduce the programming logic required for a flexible toolpath.

- Standard identifiable features (reference library)
- Availability of 3D models for most castings

More feasible to implement by SMEs

- Lowers the programming requirements for shop personnel
- Lowers cost of tooling and decreases time to program

Increasing process control

Sensoring the process (in-situ) detects problems as they happen.

Availability of inexpensive wireless with simplified programming lowers barriers to entry of SMEs.

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Automated Scanning Cell

Part verification can be a long and tedious process in the DoD supply chain. Parts often need to go through multiple dimensional checks to ensure they meet requirements and typically requires a worker to have hands on a part for hours at a time between setup and dimensional reporting.

Automated scanning cell utilizing a Fanuc CR-35iA Collaborative Robot, Creaform HandyScan Black Elite, and Metrolog X4 i-Robot Software

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Automated Scanning Cell

Key points

Less man hours required for validation work, after the initial setup process, operating the cell is easy.
- After initial setup by an engineer or technician, any person can run the program by setting a part and pushing a button.

Faster than traditional methods of scanning/validation.
- Scanning by hand takes time and is an involved process
- Touch probes such as Faro arms or CMM's have a long setup time
  - Measurements taken are only 'point' measurements

It has a more accurate, less dense point cloud
- Metrolog programs the optimal scan path based on reference model features
  - It uses scanner standoff and part geometry

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Automated Scanning Cell

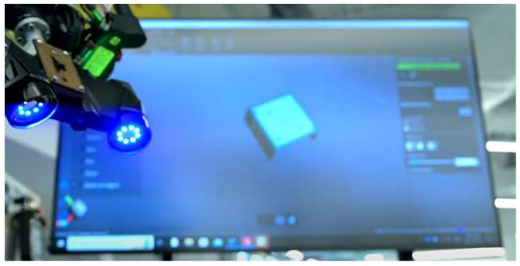
How it works

Metrolog X4 i-Robot is an agnostic program that ties in the selected robot and scanner needed for the application

- This means you can choose from almost any manufacturer of robot or measurement device.

Metrolog is the programming and reporting software

- Metrolog controls the robot and the scanner telling them how to move and operate but uses the scanners proprietary software to acquire the point cloud



By using VXElements to acquire the point cloud allows for the best possible scan data to be captured with the scanner.

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Scanning Process

Robot setup

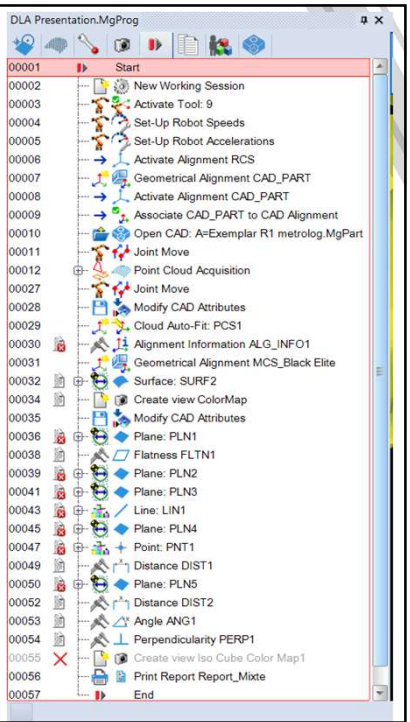
Reference CAD Data Setup

All robot movements auto programmed by Metrolog

Process for aligning scan data to reference data

Dimensions and tolerancing being measured for reporting

Final Dimensional Report



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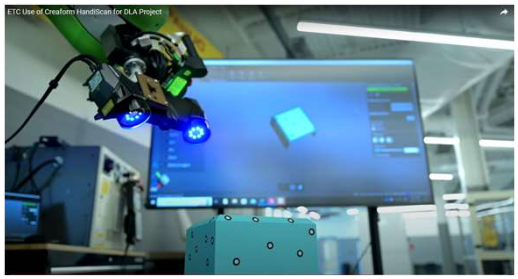
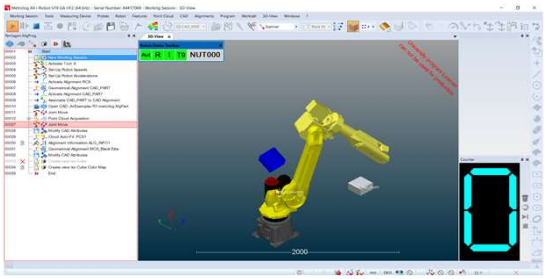
Scanning Process

Running the Program



Metrolog works directly with the Handyscan's VXElements to capture the scan data



Scan data is directly transferred into Metrolog

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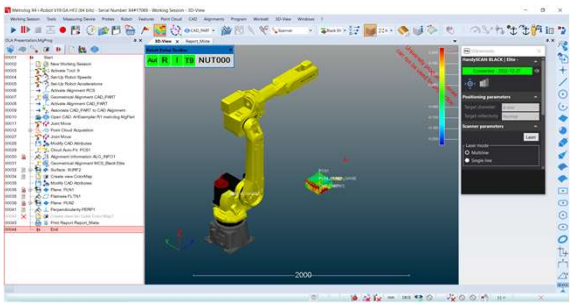
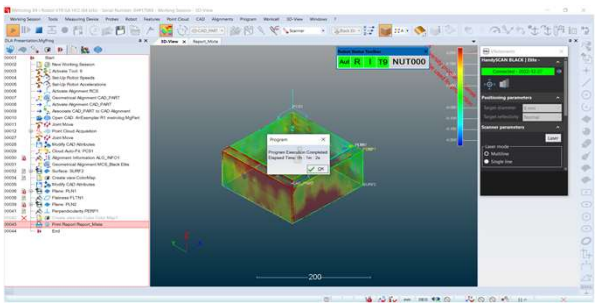
Scanning Process

Running the Program



Metrolog auto aligns the Scan Data and Cad Data



Total time from scanning to reporting is 1 minute unmanned per part

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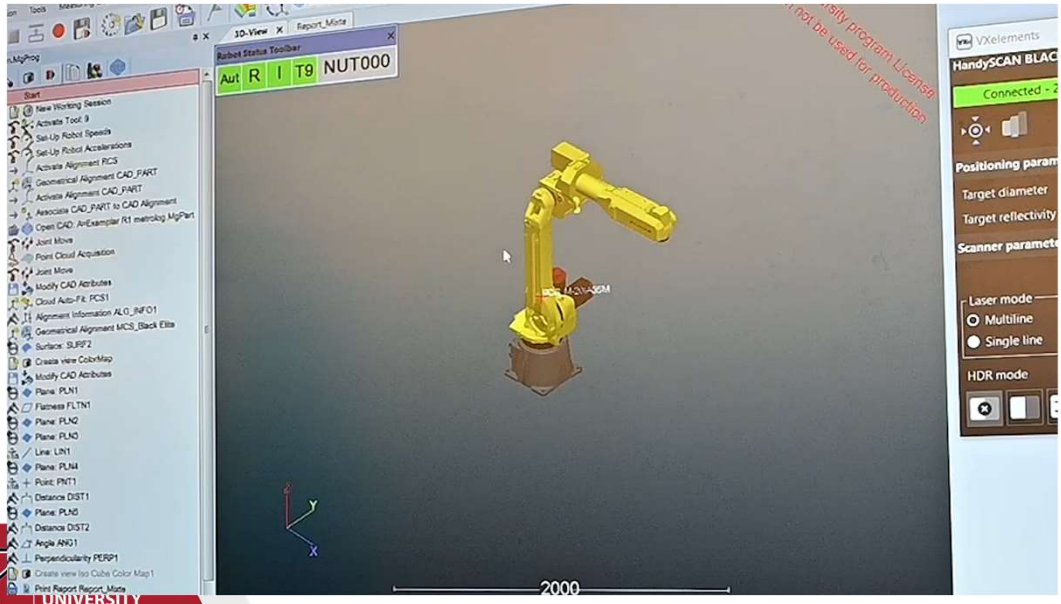
Scanning Process



Thank you!

Andrew Prokop

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