Proper Implementation of Industrial CT Scanning to Reduce Inspection Costs & Get to Production Faster

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Traditional Metrology and Inspection

Tactile Devices (Touch Probe)
- CMM - Coordinate Measuring Machine
- Cartesian Measurement Arm (ie. Faro Arm)

External Imaging
- Optical Imaging - 2D
- White Light/3D Scanners
- Laser Scanners
Traditional Metrology and Inspection

Internal Imaging
- 2D Digital Radiography, 3D X-ray
- Ultrasound
- Industrial CT (Computed Tomography)
  - it’s an x-ray technology
What is a Digital X-Ray?

A digital x-ray is performed by energizing photons through a source and capturing the results on a digital detector for viewing, after they pass through an object. Higher density objects are shown lighter and lower density objects are shown darker.
X-Ray Source
X-ray sources come in a variety of energy settings with different spot sizes. The key points for an x-ray source are:
- Source power and voltage
- Spot size
- Consistent power setting

Part Placement
The placement of the part determines how many parts can fit into a scan and the magnification that can be used.
- This distance needs to be known with high precision in order to get accurate dimensions

Detectors
A digital detector is a device that captures x-rays, converts them to light and then recorded. The inverse of what computer monitors do.
- Digital detectors come in a variety of pixel pitch’s which mean the space between pixels.
Industrial Computed Tomography systems consist of 3 main parts:

- X-Ray source
- A moveable table
- Detector

**How Industrial CT Scanning works**

The process works by rotating the part 360 degrees while taking several hundred to several thousand 2D x-rays depending on project requirements and accuracy.

Cone Beam CT *(Line Beam CT)*
Part Positioning & Setup

When scanning multiple parts per scan difficulties come into play when attempting to maximize scan resolution while achieving a successful scan.

However, if acceptable resolution expectations are met, scanning multiple parts per scan can provide significant cost savings.
A Closer Look at the types of Analysis available using Industrial CT Scanning
Failure Analysis

After a part is CT scanned, custom viewing planes are developed based upon the project's internal viewing requirements. Key details include:

- Slice by slice walk-through
- Identify internal features within parts
- Vary the scan grayscale to view objects of a given density
- Internal measurements on calibrated scans
Porosity Analysis

After a part is CT scanned. Internal voids are determined by using the grayscale value of air and the material. Internal voids are then qualified by:

- Volume of the void
- Location of the void
- Percent porosity within a part
Wall Thickness Analysis

After a part is CT scanned, an ISO Surface is created around all of the internal and external part geometry. Wall thickness is then qualified by:

- The distance between surfaces
- Whisker Plots
Geometry in a complex or limited production part is occasionally required to be validated for an integral part of an assembly.

By identifying wall thickness issues ahead of time in the first part, the design or the additive manufacturing process can be modified to ensure the production run is meeting the intended design parameters.
Part to Part Comparison

After two parts have been CT scanned, both CT datasets can compared together. Alignment is performed by either a best fit method or predetermined datum's. Difference are then qualified by:

- The distance between surfaces
- Whisker Plots
Part to CAD Comparison

After a part is CT scanned, a supplied CAD model from the customer is compared to the CT dataset. Alignment is performed by either a best fit method or predetermined datum's. Difference are then qualified by:

- The distance between surfaces
- Whisker Plots
Difficult GD&T Programming

With CT you are able to measure part features that would normally require destructive sectioning of the part if using traditional CMM.

Development of a complex measurement plan from a GD&T part print can be made to automatically calculate multiple dimensions simultaneously from a CT dataset.
**First Article Inspection**

Generation of a measurement plan to work in conjunction with predetermined call outs on supplied GD&T part prints. After a program is written, each time a scan is performed for the same or handed part all programmed points are now automatically calculated. The results are shown in a +/- spreadsheet similar to what you would receive with a CMM report.

- FAI Reports
- PAPP Reports
- AS9102 Form 3
Composite Analysis

Importing one unique CT dataset and analyzing to determine the size and length of fibers. Fibers are then qualified by:

- Length
- Diameter
- Percent Direction
Viewing Software

The viewing software allows the customer to rerun any of the analysis previously described. The user can also view how the analysis was performed, rotate the part, cut cross sectional slices in the data, vary the density scale while viewing the part.
Reverse Engineering

After a part has been CT scanned, internal and external data are extracted from the results. Data can be currently exported in the following formats: STL, WRL, TXT, PLY, OBJ.

Additional Benefits:

STL To STEP
Point Cloud to Surface Files

FEA Analysis/Mold Flow/ Magma
One CT scan produces a variety of analytics to satisfy all your testing needs

Complete Quality Control Validation Process

Void Analysis  Wall Thickness Analysis  Part to CAD Comparison  Part to Part Comparison  First Article Inspection  Reverse Engineering
What you want is a successful scan, inspection, and analysis of your part to make a qualified decision

- Use the right machine configuration
- Calibrate the system
- Reconstruct the data accurately
- Analyze the data properly
- Relay the information properly to the end user
The Benefits of Industrial CT Scanning?

- Parts are scanned in a free state environment without fixtures
- Internal complex part features can be precisely measured on micro parts up to large parts
- Development costs are reduced in creating the first CAD model
- Product quality is improved to reduce the risk of recalls
- Pre-production inspection and analysis are significantly reduced for complex parts
- Between internal inspection and the types of analysis developed for CT, there are very few, if any, other methods available to provide this kind of data and these results
When should you use Industrial CT Scanning?

- Pre-production/prototype stage
- Production stage
- Lot Inspection
- Failure Inspection
- Reverse Engineering
Why should you use Industrial CT Scanning?

- Save Time
- Reduce Cost
- Add Value
How should you use Industrial CT Scanning?

Now that you know how CT works, it is up to you to identify areas within your company that can utilize this technology. By identifying the right fit in your company you can save both time and money in addition to developing a superior product.

Depending on your needs for CT, you may want to consider setting up an in house lab to scan large numbers of multiple parts of similar sizes and materials. The reason similar sizes and materials are highlighted are that one CT machine does not do all types of parts and CT machines are usually built to handle a very specific application.

If your needs are more infrequent or your parts vary in shape, density, and size you may want to consider an experienced CT Scanning Service company that has a wide variety of calibrated CT machines and experienced staff.
About JG&A Metrology Center:

JG&A Metrology Center is a specialized lab focused on providing 3D internal part inspection services using Industrial Computed Tomography Equipment.

With over 18,000 parts CT scanned, spanning close to a decade, in ten different industries, JG&A Metrology Center continues to invest in Industrial CT Scanning by increasing its capabilities to support CT as a viable non-destructive inspection method.
Questions?

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