

X-RAYLAB

QUALITY SHINES THROUGH

Computer Tomography
3D-Measurement
Non-Destructive Testing
3D-Object Scanning
www.XRAY-LAB.com



Quality Shines Through

Presenters:

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Gerd-Heinrich Greiwe – CT Applications Engineer

X-RAY LAB

- Founded in 1998 as a small family business focused on rework and audit support
- Currently multinational company, with resident engineers providing a broad spectrum of services
- Research and Development:
 - PolyCT www.polyct.com
- Departments:
 - X-Ray
 - NDT
 - Quality Engineering
 - Special Machines and Systems Development



What sets us apart?

Expertise in:

- 2D, 2.5D Radiography (RT)
 - Electronic
 - Solder Joints
 - Mechanical Assemblies
- Computed Tomography (CT)
 - Voids and Porosity Analysis
 - Wall Thickness Measurements
 - Fiber Orientation
 - CAD Comparison
 - 3D Measurements
- Ultrasonics Inspection (UT)
- Eddy Current Inspection (ET)
- Magnetic Particle Inspection (MT)
- Dye Penetrant Inspection (PT)
- Custom Systems and Machine Development



Global service infrastructure

USA

Auburn Hills (HQ US)
Michigan
Tuscaloosa (US South)
Alabama



Germany

Wolfsburg (North)
Niedersachsen
Stuttgart (HQ)
Baden-Württemberg

Slovakia

Stupava

Czech Republic

Nove Hamry

Inline CT and Analysis of up to 3,600 Parts per Hour

Case Study: CAP

Challenge:

How to inspect and analyze thousands of parts in just one hour?

Background:

Case study component is being mass produced at a rate of up to 3600 units each hour. The components are made from a polysulfite mix.

To pass quality check the component has to be within allowable CAD tolerances and be analyzed for internal voids, with additional accept-reject criteria.

SETUP

Source: 300kV Microfocus

kV: 150 kV

μ A: 350 μ A

Timing: 125 ms

Geometric Magnification: 2.5x

Scan capacity: 125 components (1 stack)

Load/unload time: 30 sec (auto/semi automated)

Detector: 2024 x 2024 pixel detector

Pixel Size: 200 μ m

Scan time: 90 seconds

Total Cycle Time: 120 seconds

Filter: 0.3 mm Cu

Averaging: none

Inline CT and Analysis of up to 3,600 Parts per Hour

Initial approach:

- Batch (stack) fast scan
- Full volume reconstruction
- VG Studio Max 3.0 processing
 - Separation of individual CAPs
 - Extraction
(This task was initially done manually.
Very time consuming.)
 - Followed by analysis.

Writing Macros in
VG Studio Max 3.0:

Surface determination

CAD Import

CAD Allignment

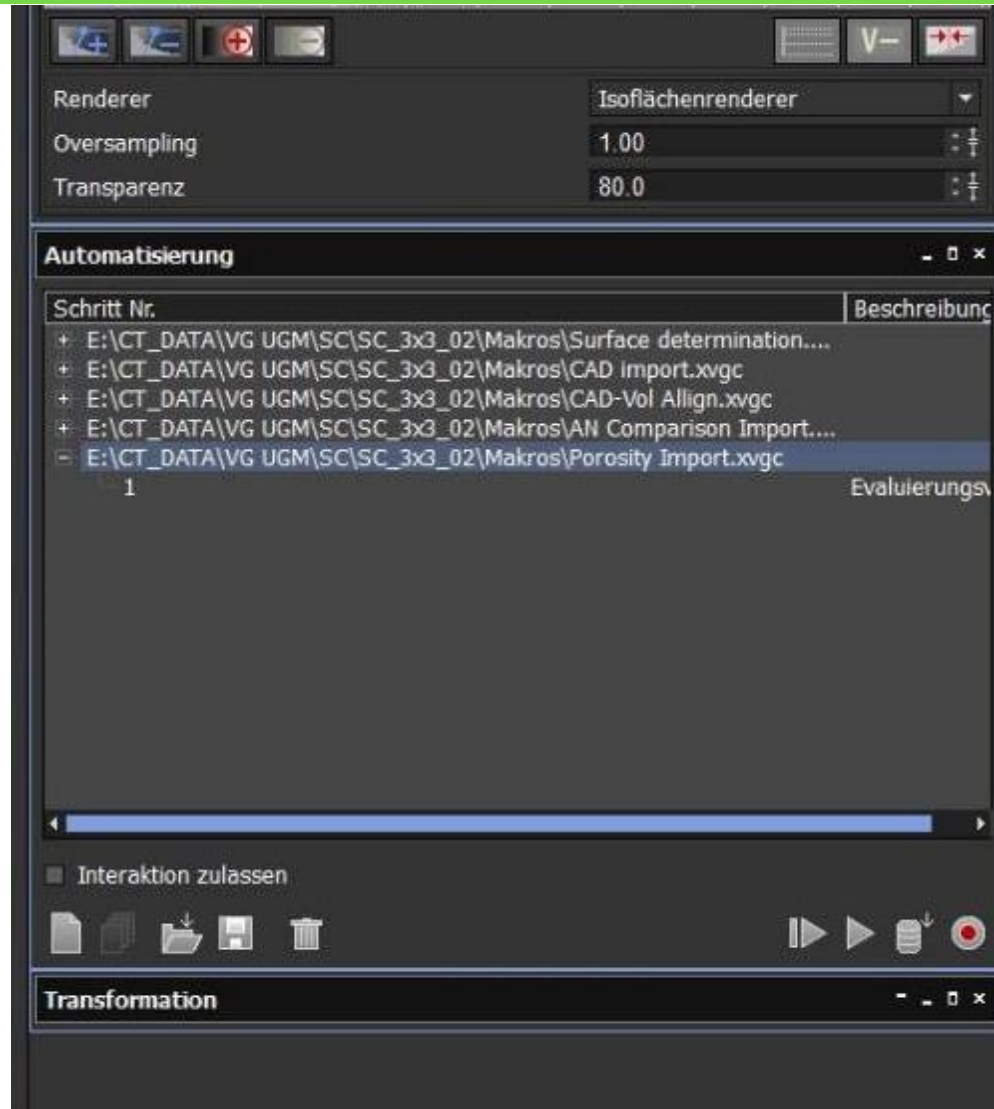
Actual Nominal
Comparison

Porosity Analysis

Inline CT and Analysis of up to 3,600 Parts per Hour

Writing Macros in VG Studio Max 3.0:

- Some tools are macro compatible
- Some tools involve work around solutions



Inline CT and Analysis of up to 3,600 Parts per Hour

VG InLine Programming:

- Setting up the workspace
- Adding workers
- Creating jobs



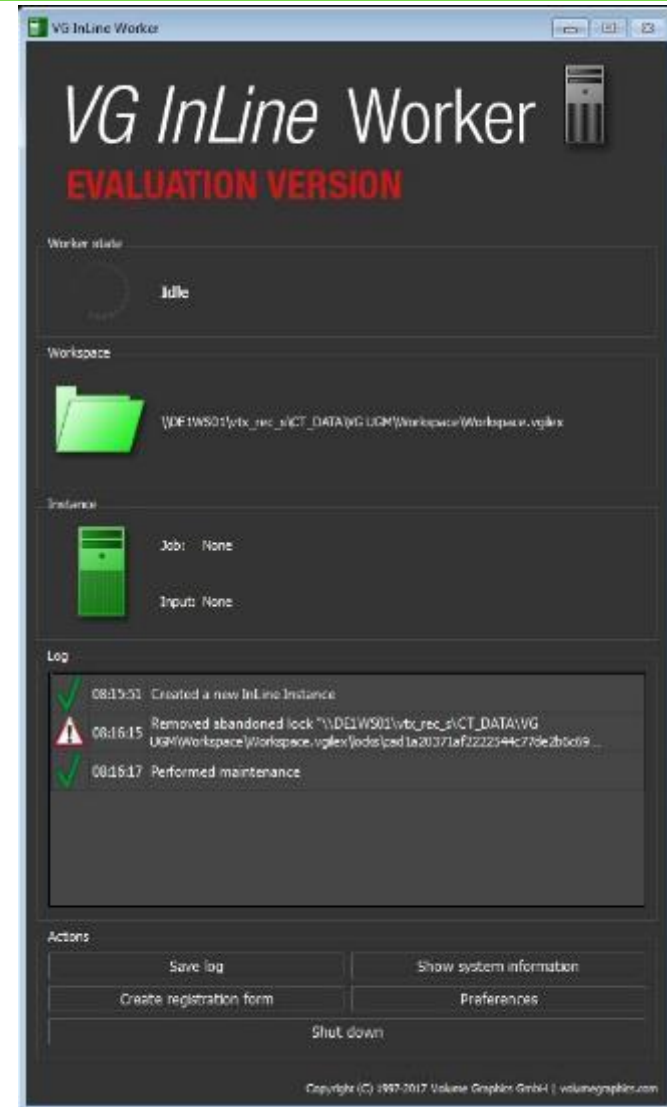
Inline CT and Analysis of up to 3,600 Parts per Hour

Writing up Jobs in VG InLine



Inline CT and Analysis of up to 3,600 Parts per Hour

Starting up the worker



Inline CT and Analysis of up to 3,600 Parts per Hour

Executing the Job in VG InLine



VG InLine Worker
EVALUATION VERSION

Worker state: Processing

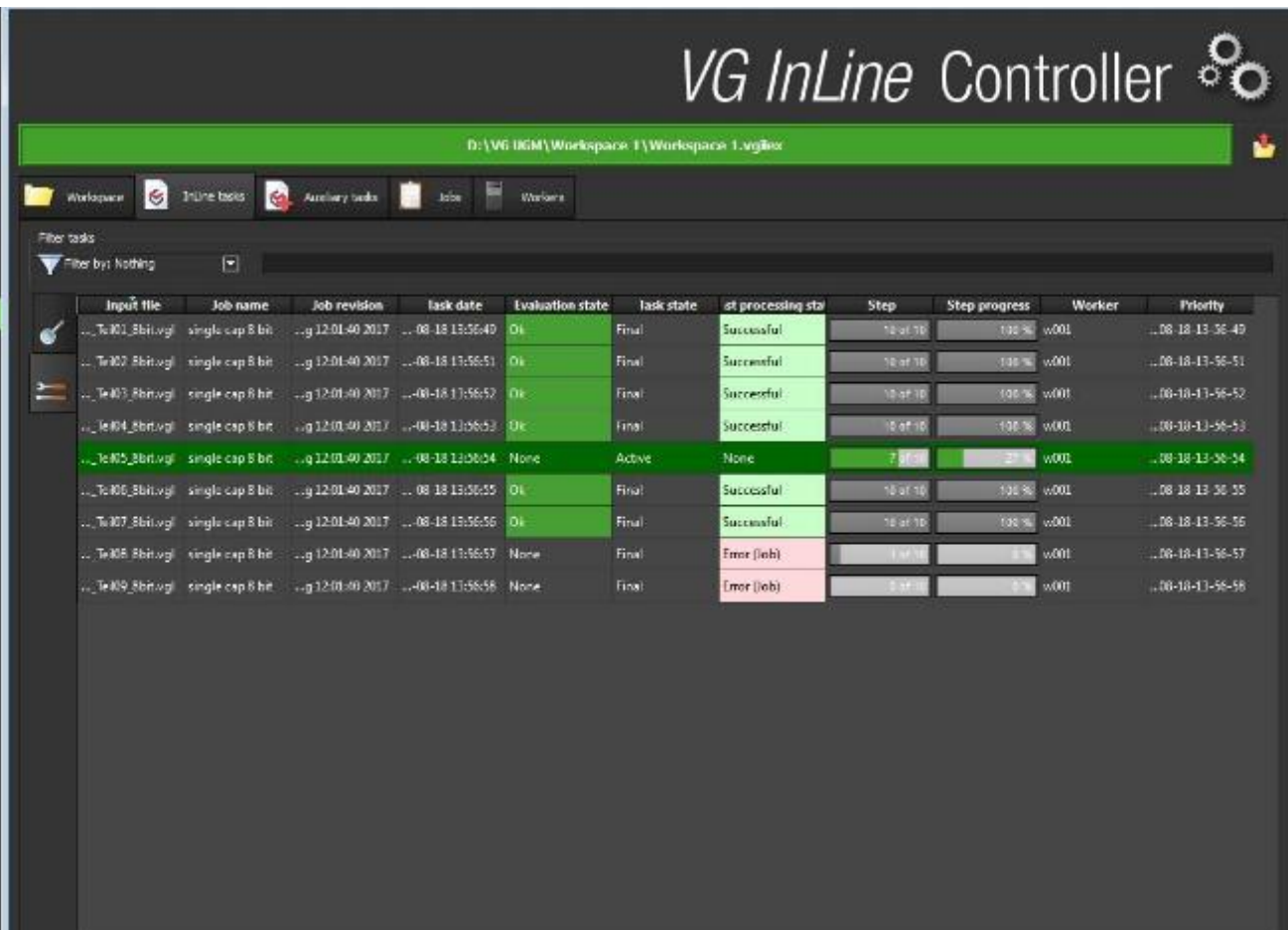
Workspace: D:\VG UGM\Workspace 1\Workspace 1.vglin

Instance: Job: single cap 8 bit
Input: D:\VG UGM\SC_3x3_02\08KSC_3x3_02_T#05_8bit.vg

Log:

- 12:07:17 Created a new InLine Instance
- 12:08:42 Successfully processed task [D:\VG UGM\SC_3x3_02\08KSC_3x3_02_T#04_8bit.vg] with job "single cap 8 bit"
- 12:08:42 Successfully finished task [D:\VG UGM\SC_3x3_02\08KSC_3x3_02_T#04_8bit.vg] with job "single cap 8 bit"
- 12:08:44 Could not process task - check run log for details [D:\VG UGM\SC_3x3_02\08KSC_3x3_02_T#05_8bit.vg] with job "single cap 8 bit"
- 12:08:44 Could not process task - check run log for details [D:\VG UGM\SC_3x3_02\08KSC_3x3_02_T#06_8bit.vg] with job "single cap 8 bit"
- 12:09:09 Created a new InLine Instance

Actions: Save log, Show system information, Create registration form, Preferences, Shut down



VG InLine Controller

D:\VG UGM\Workspace 1\Workspace 1.vglin

Workspace | InLine tasks | Auxiliary tasks | Jobs | Workers

Filter tasks: Filter by: Nothing

Input file	Job name	Job revision	Task date	Evaluation state	Task state	is processing	Step	Step progress	Worker	Priority
..._T#01_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:49	Ok	Final	Successful	18 of 18	100%	v001	...08-18-13-56-49
..._T#02_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:51	Ok	Final	Successful	18 of 18	100%	v001	...08-18-13-56-51
..._T#03_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:52	Ok	Final	Successful	18 of 18	100%	v001	...08-18-13-56-52
..._T#04_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:53	Ok	Final	Successful	18 of 18	100%	v001	...08-18-13-56-53
..._T#05_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:54	None	Active	None	7 of 18	20%	v001	...08-18-13-56-54
..._T#06_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:55	Ok	Final	Successful	18 of 18	100%	v001	...08-18-13-56-55
..._T#07_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:56	Ok	Final	Successful	18 of 18	100%	v001	...08-18-13-56-56
..._T#08_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:57	None	Final	Error (Job)	1 of 18	0%	v001	...08-18-13-56-57
..._T#09_8bit.vg	single cap 8 bit	...g.12.01.40.2017	...08-18 13:56:58	None	Final	Error (Job)	0 of 18	0%	v001	...08-18-13-56-58

Inline CT and Analysis of up to 3,600 Parts per Hour

Monitoring the process in VG Inline



VG InLine Worker
EVALUATION VERSION

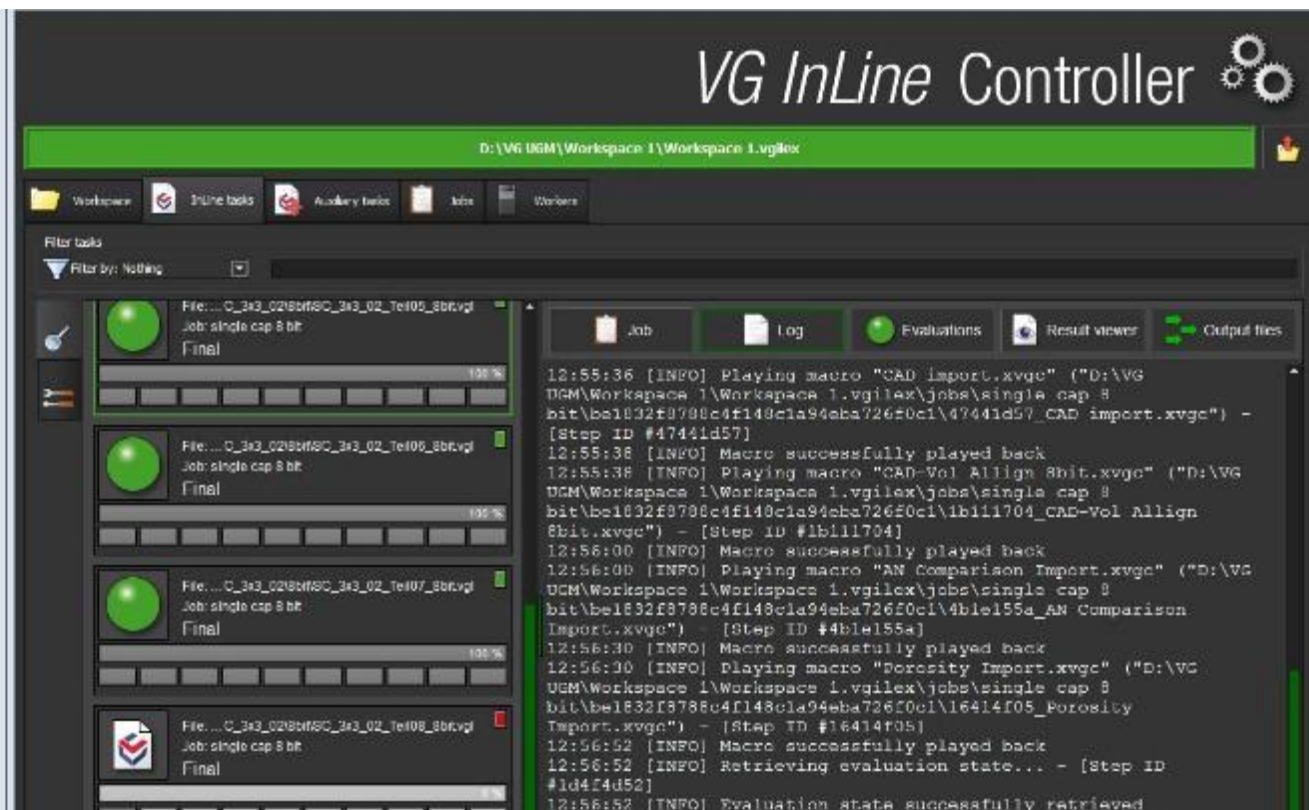
Worker state: Idle

Workspace: D:\VG UGM\Workspace 1\Workspace 1.vgilex

Instance: Job: None, Input: None

Log:

- 12:07:17 Created a new InLine Instance
- 12:08:42 Successfully processed task [D:\VG UGM\SC_3_5_02\8bit\SC_3_5_02_Tel04_8bit.vgl] with job "single cap 8 bit"
- 12:08:42 Successfully finalized task [D:\VG UGM\SC_3_5_02\8bit\SC_3_5_02_Tel04_8bit.vgl] with job "single cap 8 bit"
- 12:08:44 Could not process task - check run log for details [D:\VG UGM\SC_3_5_02\8bit\SC_3_5_02_Tel05_8bit.vgl] with job "single cap 8 bit"
- 12:08:44 Could not process task - check run log for details [D:\VG UGM\SC_3_5_02\8bit\SC_3_5_02_Tel06_8bit.vgl] with job "single cap 8 bit"
- 12:09:09 Created a new InLine Instance



VG InLine Controller

D:\VG UGM\Workspace 1\Workspace 1.vgilex

Workspace | InLine tasks | Auxiliary tasks | Jobs | Workers

Filter tasks: Filter by: Nothing

Job | Log | Evaluations | Result viewer | Output files

Log:

```

12:55:36 [INFO] Playing macro "CAD import.xvgc" ("D:\VG UGM\Workspace 1\Workspace 1.vgilex\jobs\single cap 8 bit\ba1832f8788c4f148c1a94eba726f0c1\47441d57_CAD import.xvgc") - [Step ID #47441d57]
12:55:38 [INFO] Macro successfully played back
12:55:38 [INFO] Playing macro "CAD-Vol Align 8bit.xvgc" ("D:\VG UGM\Workspace 1\Workspace 1.vgilex\jobs\single cap 8 bit\ba1832f8788c4f148c1a94eba726f0c1\1b111704_CAD-Vol Align 8bit.xvgc") - [Step ID #1b111704]
12:56:00 [INFO] Macro successfully played back
12:56:00 [INFO] Playing macro "AN Comparison Import.xvgc" ("D:\VG UGM\Workspace 1\Workspace 1.vgilex\jobs\single cap 8 bit\ba1832f8788c4f148c1a94eba726f0c1\4b1e155a_AN Comparison Import.xvgc") - [Step ID #4b1e155a]
12:56:30 [INFO] Macro successfully played back
12:56:30 [INFO] Playing macro "Porosity Import.xvgc" ("D:\VG UGM\Workspace 1\Workspace 1.vgilex\jobs\single cap 8 bit\ba1832f8788c4f148c1a94eba726f0c1\16414f05_Porosity Import.xvgc") - [Step ID #16414f05]
12:56:52 [INFO] Macro successfully played back
12:56:52 [INFO] Retrieving evaluation state... - [Step ID #1d4f4d52]
12:56:52 [INFO] Evaluation state successfully retrieved
    
```

The Results?

The analysis of one single component came down to 1 minute and 30 seconds.

Not good enough.

What next?

Bottlenecks

The following steps were bottlenecks in the process:

1. Reconstruction of the entire volume
2. Extraction of individual CAPs as separate volumes
3. Transition time between completing the analysis of one component and moving to the next component

Solutions

The following steps were taken to remove the bottlenecks in the process:

1 and 2.

Writing macros in the acquisition and reconstruction software. Reconstruction is on the fly and allows creation of individual volume files for each component in the stack.

Reduction of data files (both raw data as well as reconstructed data) to smaller formats. Acquisition, reconstruction, and analysis is performed much faster. on the small data set.

Results: Analysis time reduced to 30 seconds for each component.

Improvements can be made with an upgraded worker (work station) and analysis is estimated to be reduced to approximately 15-20 seconds.

Solutions

The following steps are future developments to remove the bottlenecks in the process:

3. Implementation of multiple workers will allow the processing of multiple individual volumes at the same time.

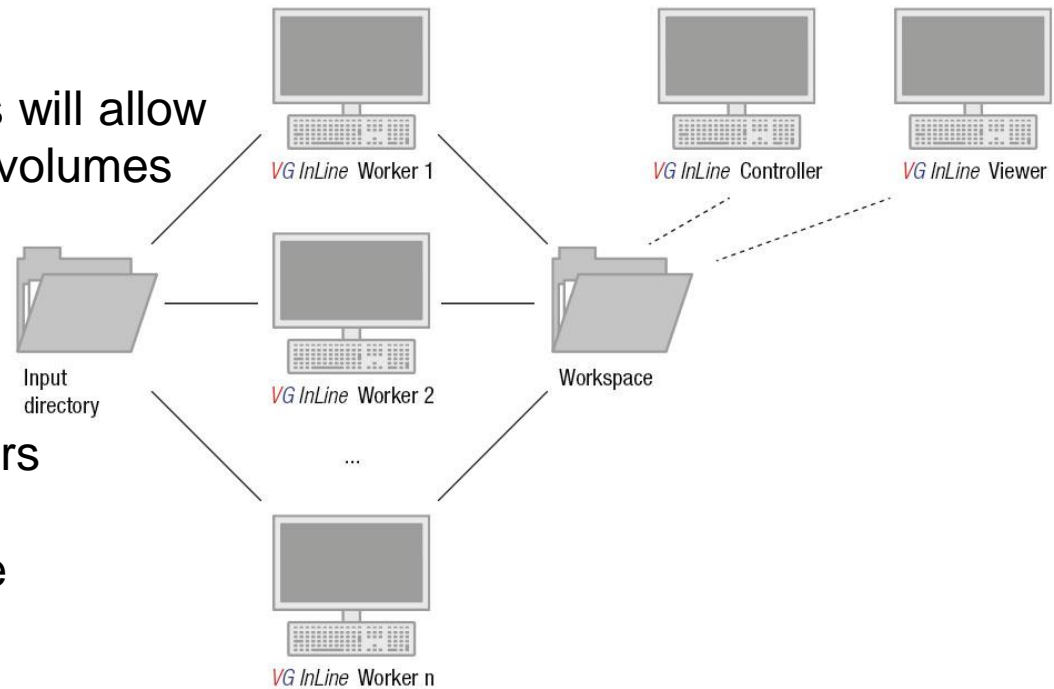
Est. analysis time: 15-20 sec/part

Recommended Work force: 15 workers

Output: 80 – 120 parts per scan cycle

Scan Cycle: 120 seconds

Overall output: up to 30 stacks per hour (approx. 3600 parts per hour.)



Conclusion

Lessons learned:

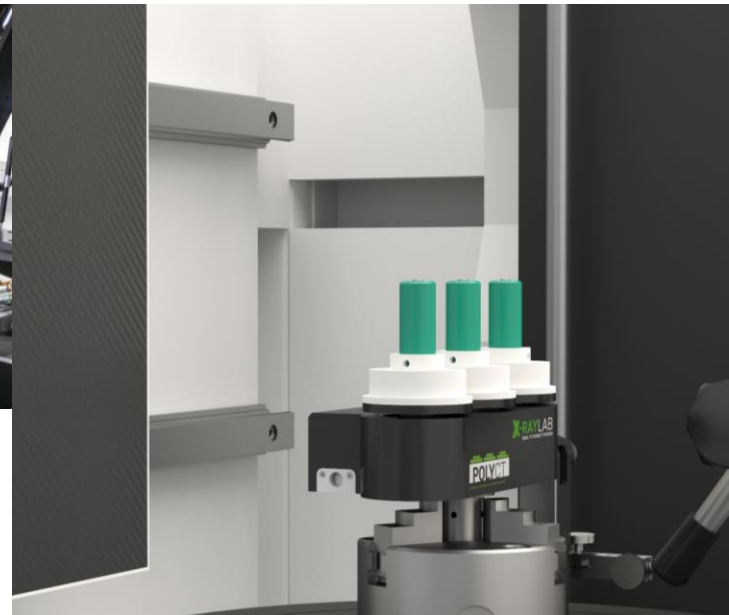
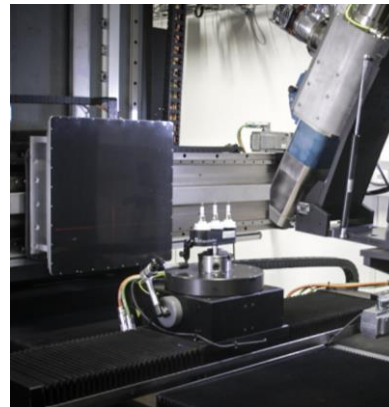
- Batch scanning to allow increased throughput
- Reducing the size of the data sets to allow faster processing
- Automation using macros (acquisition, reconstruction, analysis, processing)
- Scaling up the computing resources to meet the required production rates

Future Developments

POLY CT Technology

- Implementation of POLY CT to increase the throughput of scanned parts
- More development required from the current configuration

www.POLYCT.com



Questions ?

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