ReCap - Scanning and Post Processing Workflows for All Manufacturing Plants

Tim Vetter

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Stamping Manufacturing Equipment Engineer (SEE)
Digital Manufacturing Validation Pillar Co-Lead (DMV)

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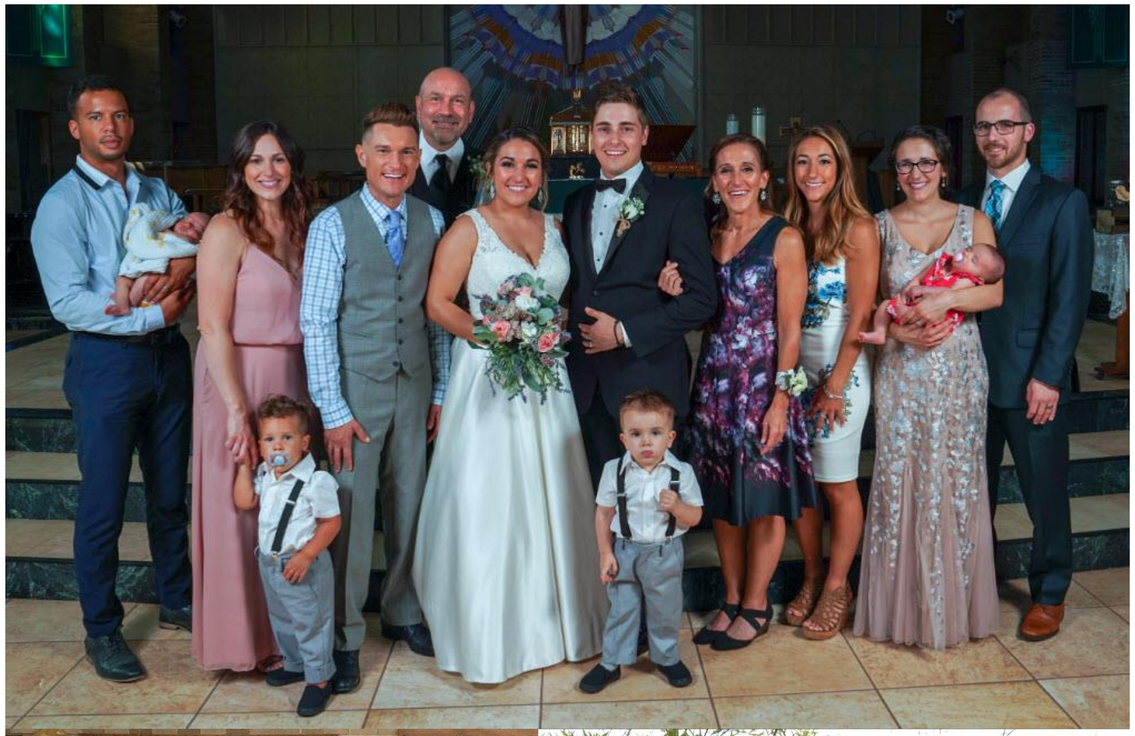

- Married in 1990.
- A growing family!
- Empty nesters!

About the speaker

Tim Vetter

Stamping Equipment Engineer,

FCA Group (Chrysler)

FCA

FIAT CHRYSLER AUTOMOBILES

- Powertrain Manufacturing Engineer starting in 1995.
- Member of WCT-Digital Manufacturing pillar team since 2015.
- Implemented first laser scan @ FCA in Jan. 2016.
- Stamping Equipment Engineer starting in Nov. 2017.
- WCT-Digital Manufacturing pillar team co-lead in 2019.

Mentors and Technical Resources

David Dreffs

Director of Services,
Reality Capture Specialist,
Cintoo US Inc.
AU Speaker & Tech. Resource

Mike Jolicoeur

Sr. Tech Specialist,
Mfg. Subject Matter Expert,
Factory Solutions,
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Mark LaBell Jr.

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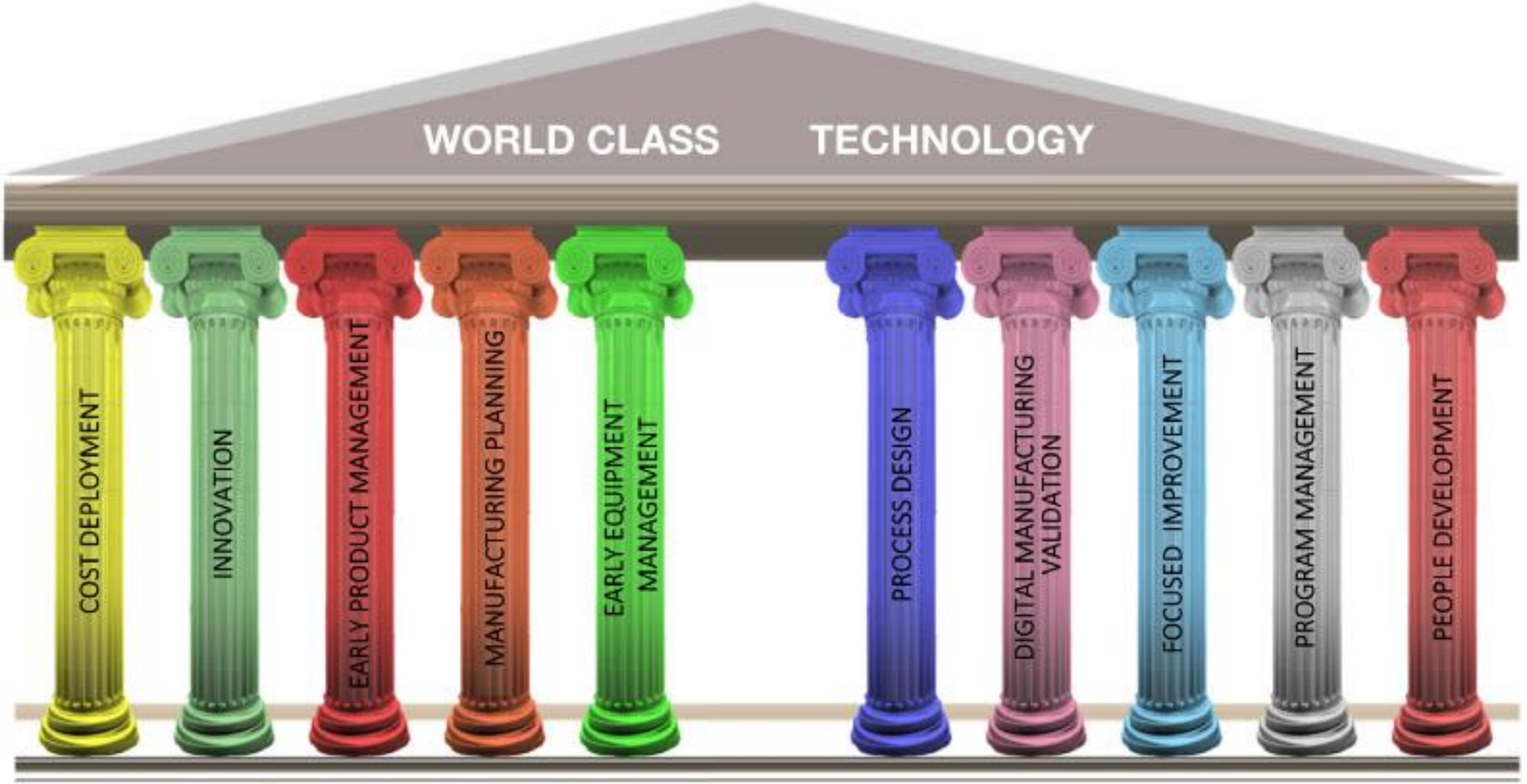
AU Speaker & Mentor

Robert Ostermann.

Digital Factory Designer,
Magna Steyr
AU Speaker & Tech. Resource

Autodesk Support


WORLD CLASS TECHNOLOGY
COST DEPLOYMENT
INNOVATION
EARLY PRODUCT MANAGEMENT
MANUFACTURING PLANNING
EARLY EQUIPMENT MANAGEMENT
PROCESS DESIGN
DIGITAL MANUFACTURING VALIDATION
FOCUSED IMPROVEMENT
PROGRAM MANAGEMENT
PEOPLE DEVELOPMENT

Learning Objectives

- **Field Data Collection** - Optimize laser scan settings, target use, and field workflows on your next project to achieve high quality project registrations under .5mm overall RMS.
- **Project Creation** - Range clipping, RCC/RCS files, and other initial workflows
- **Post Processing** - Eliminate field survey costs by creating “virtual” surveyed monuments, rather than physical monuments, to aid registration and alignments.
- **Quality Verification** - Use the limit box for elevation slices and other workflows to verify registration and alignment quality. Export decimated point cloud data files for use in downstream applications and improving the performance of ReCap.

Learning Objectives Class Progress

- Recap Software: Scanning and Post Processing Workflows for All Manufacturing Plants
  - 1) Field Data Collection
    - A) FCA Standards
    - B) Scanner Hardware and Recap Software Calibrations - DOC LINK
    - C) Facility and Equipment Scanning Workflows - DOC LINK
  - 2) Project Creation Workflows
    - A) Batch Import Scan Workflows - DOC LINK
    - B) Merging and Reusing RCP Project Files - DOC LINK
  - 3) Post Processing Workflows
    - A) Registration Best Practices - DOC LINK, VIDEO
    - B) Alignment Best Practices - DOC LINK, VIDEO
    - C) Data Cleanup and Project Preparation - DOC LINK
    - D) Decimation Workflows - DOC LINK
    - E) Virtual Monuments - DOC LINK, VIDEO
  - 4) Quality Verification Workflows
    - A) Registration and Alignment Reporting - DOC LINK
    - B) Elevation Slices and Using the Limit Box. - DOC LINK, VIDEO
    - C) Import CAD geometry to Recap. - DOC LINK

Field Data Collection
A) FCA Standards

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Facility Laser Scanning Standard

Version 1.2.0

Point Cloud Standards

- ReCap is still FCA Stamping's internal standard software but requires outside suppliers to use manufacturers' software for registration.
- Recap's compatibility with many different OEM's hardware file formats is a key feature.
- Target use is mandatory for registration and alignments.

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Manufacturing CAD Requirements (MCR)

For Stamping Plants

February, 2019

Mfg. CAD Requirement Standards

- Added working with point clouds as a CAD competency requirement for equipment design.
- Added requirement for OEM 3D space claim model, during the RFQ process, to confirm equipment will fit in our plants.
- Added requirement that BIM workflows verify a clash free installation prior to equipment build approval.

Field Data Collection
B) Scanner Hardware and Recap Software Calibrations

- **Goal1:** To get familiar with the capabilities of different scanner hardware systems and understand the use of white sphere targets.
- **Goal2:** To confirm the scanner hardware remains within calibration using target locations of known distances.
- **Goal3:** To confirm Recap software's ability and repeat-ability to find center of targets at known/verified distances and at different scanner resolutions (½, ¼, ⅕, ⅛).
  - **ReCap software can calculate and find the center of target, on the same scan data, within .1mm This is great! How did I confirm this?**
- **DOC LINK**

Field Data Collection
C) Facility and Equipment Scanning Workflows

- **Goal1**: Understand what equipment is needed to perform high quality scanning.
- **Goal2**: Understand the difference between facility and equipment scanning.
- **BEST PRACTICE:** Create a field map of scan locations for registration later.
- **BEST PRACTICE:** Field scanning should follow aisles/border of the area of interest first, followed by the internal area if needed (i.e., like solving a puzzle).
- **Required equipment**: 200mm large diameter spheres improve registration / alignment over longer distances (ideal for facility wide scans; not as important for detailed equipment scans).
- **Facility versus equipment scanning recommendations**: Scanner setup and configurations, scan centers, and target placement tips.
- **DOC LINK**

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Project Creation Workflows
A) Batch Import Scan Workflows

- **Goal1**: Understand important project creation settings and undocumented improved workflows.
- **BEST PRACTICE:** Batch create RCS/RCC files from the native OEM scans by using ReCap software to import and index. (Do not use the Pro version for this batch conversion tip.)
- **BEST PRACTICE:** Filtering tab - Range Clipping: Typically use **35m** in the basement and **40m** for main aisle facility scans on the manufacturing floor. For equipment scans, stay within **25m**. (This tip reduces the scan's file sizes and imports the more accurate point locations by excluding longer range, less accurate point locations.)
- **BEST PRACTICE:** Reuse RCS/RCC files in the support folder when possible to skip the import and index time when creating a new project. Save the cleaned up and range clipped RCC/RCS scan files with people and traffic removed.
- **Idea: Retain target information in RCS/RCC files**
- **DOC LINK**

Project Creation Workflows
B) Merging and Reusing RCP Project Files

- **Goal1**: To combine RCP projects beyond C2C registration. Is this possible?
- **Issue:** Autodesk support confirmed that combining target enhanced scan groups within a project can create “target metric computation issues”. Save often!
- **Issue:** Target creation and then target enhanced registration as a final step for each group in a project will result in a crash. Save often!
- **Idea:** **Existing RCPs added into a new RCP should keep the source registration**
- **Workaround:** To keep the source registration, export target enhanced registration and aligned ReCap projects as E57 files 'Complete' not '3D-only' then import the E57 files and bypass the registration in a new RCP. It works great but adds time.
- **DOC LINK**

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Post Processing Workflows
A) Registration Best Practices

- **IMPORTANT:** There are two main types of C2C registration issues based on your site conditions. The site conditions at FCA have examples of both registration issues which is why targets are a mandatory requirement.

1. Good balance values above 25% but ReCap overlaps or mixes up the positions of most scans. This condition occurs in the basement and material storage areas at typical stamping plants.

2. Poor balance values below 20% where ReCap struggles to find matching surfaces. This condition occurs on the main plant floor where there are large open spaces, low X, Y, Z surfaces to match and lots of movement.

Post Processing Workflows
A) Registration Best Practices

- **Goal1:** To verify the quality of a standard C2C project using targets.
- **Goal2:** To replace and improve the C2C registration using target enhancements.
- **Goal3**: To add virtual monument scans and target coordinates to your project.
- **BEST PRACTICE:** Manually choose bigger white sphere targets first unless medium sizes are needed for backup. ReCap is **very good** at finding the center of targets.
- **IMPORTANT:** The C2C report does not identify how good the registered scans fit together. Target use is the only method to verify the C2C quality metric.
- **IMPORTANT:** Target enhanced registration will produce better results than C2C. Also, targets are the best method to align point cloud projects.
- **Idea**: Auto-recognize white sphere targets Similar idea: WEB LINK2
- **DOC LINK**

Post Processing Workflows
B) Alignment Best Practices

- **Goal1**: To quickly level a ReCap project. Use the plant floor, bottom of crane girders, or bottom of truss. Show the limit box method to confirm a level project.
- **Goal2**: To export the unified, cropped, and decimated RCS scan data into the 2D plant grid using AutoCAD.
- **Goal3**: To rotate and move the referenced RCS file using AutoCAD.
- **Goal4**: To insert a 3D virtual monument block using AutoCAD and manually transfer the resulting coordinate locations back into ReCap.
- **Idea**: Make survey points with 1, 2, or all 3 axis values
- **Idea**: Survey point coordinates for aligned projects
- **Idea**: Point Cloud Alignment DOC LINK

Post Processing Workflows
C) Data Cleanup and Project Preparation

- Acknowledge OEMs have hardware and software workflows for auto-data cleanup.
- **Hardware solution**: Leica RTC360 double pass scans to remove data not present in second pass (e.g., people, aisle traffic, etc.).
- **Software solution**: Faro Scene software removes this data.
- **Auto-data cleanup**: Recap (2020) has removed this feature, so manual cleanup of aisles and data outside the area of interest is quick and easy.
- **Mini-map:** Elevation sections to separate mezzanine, main floor, and basement.
- **Scan regions** (aka layers)**:** Can dramatically slow down performance.
- 2016 AU Screencast: “Reducing Waste Through Reality Capture-Utilizing Scan Data Not Scan to BIM” - Mark Labell & Tony Paupert – SSOE Group
- **DOC LINK**

Post Processing Workflows
D) Decimation Workflows

- **Goal1**: To export decimated and unified RCS files for use in downstream applications. Point cloud exports are typically created from plant elevation slices.
- **Goal2:** To reduce overall project size and improve performance.
- **Floor:** With marking details = 8mm. Floors with no marking details = 20mm. (+/- 25mm elevation slice). Basement floors, with slope, require +/- 100mm elevation.
- **Equipment:** 2mm (above the floor and below the truss).
- **Truss or girder beams in the pressroom:** (bottom of beams to the roof = 5mm).
- AU2017 Screencast: “ReCap to the Max! How to Edit, Document, and Coordinate” Mark Labell, SSOE Group. ReCap Hack (at 38 minutes) shows a great workflow to reduce project size and improve performance.
- **DOC LINK**

Post Processing Workflows
E) Virtual Monuments

- **Goal1**: To add virtual monument scans into a ReCap project (C2C workflow).
- **Goal2**: To create and locate virtual monuments in AutoCAD.
- **Goal3**: To data-extract virtual monument coordinate locations in AutoCAD.
- **Goal4**: To batch import virtual monument coordinate locations into ReCap.
- **IMPORTANT**: Before starting this workflow, the ReCap project has a target enhanced registration with an overall RMS under 1mm. Under .5mm should be an easy goal. The project has been accurately registered and aligned using the workflows explained in sections 3A and 3B.
- **DOC LINK**

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Quality Verification Workflows
A) Registration and Alignment Reporting

- **Goal1**: To read the registration reports and determine quality work.
- Reporting is not user friendly, does not sort columns, lacks important detail to determine registration quality, lacks a graphics interface, lacks exporting formats.
- **Bottom line**: The reporting function needs a lot of work here…
- **Idea**: Graphic interface, based on scan locations, for registration reporting
- **Idea**: Display scan location reporting data after C2C registration is complete
- Scan accuracy and point density by Autodesk Support
- **DOC LINK**

Quality Verification Workflows
B) Elevation Slices

- **Goal1**: To master the limit box to confirm project quality.
- **Workflow**: By Autodesk Support
- **IMPORTANT:** Difference between flatness and level: A cloud project floor can be flat but not level.
- **IMPORTANT:** Refrain from ReCap's plane feature which determines a flat plane but not level or vertical. The flatness tolerances are not specified or known. Use the limit box for this purpose to confirm if your project is level or vertical within specified limits.
- **DOC LINK**

Quality Verification Workflows
C) Importing CAD geometry to Recap

- **Goal1:** To learn how to add CAD geometry to ReCap.
- **Workflow:** By Autodesk Support: This CAD import feature will display NWD files (Navisworks). Can be a quick check to make sure your point cloud project is aligned to project data: CAD Import (Short 1 minute video)
- **Workflow:** By Buddy Legnon (Autodesk): ReCap to Plant to Navis & Back
- Attach projects using the method outlined in the above video or use this Autodesk Support link: Attach a Navisworks Project
- **Idea**: Point Cloud Alignment
- **DOC LINK**

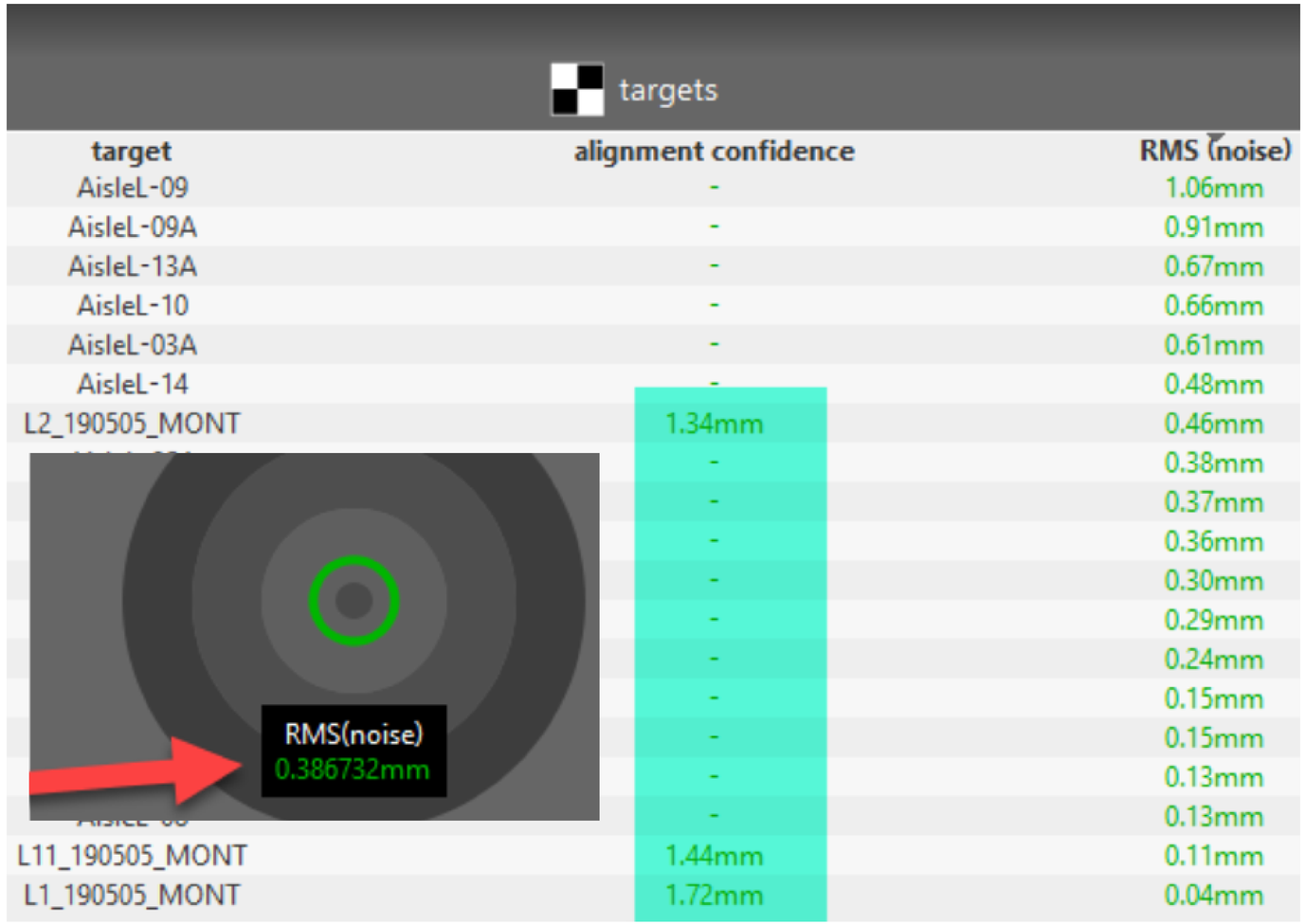
Summary of ReCap Ideas to Support by Priority

1. Auto-recognize white spheres during the auto-registration process. (11-2018)
2. Merging Projects (11-2016) (Gathering Support)
3. Existing RCPs added into a new RCP should keep the source registration (dup)
4. Retain Target information in RCS/RCC files (save target info in scan not the RCP)
5. Point Cloud Alignments (5-2016)
6. Translate/rotate coordinate system (7-2015) (This feature added to release 2020.1)
7. Survey Point Coordinates for Aligned Projects (4-2018)
8. Routine to batch convert native OEM scans to RCS/RCC (6-2017)

Summary and Wrap-up

So… how is your alignment confidence? Um, I actually mean confidence you can answer YES to the following question:

- Assuming you were already familiar with the basics of ReCap software, are you confident this class covered the necessary workflows, to achieve an overall RMS registration under **.5mm** and a project alignment confidence under **3mm?**
- If no, then meet with me during this week or in the future. I want to meet you too. I love solving challenges!



YouTube Channel for Visual Learners

Tim Vetter

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Workflow 3E-Virtual Monuments

21 views • 1 week ago

Bug-ReCap software Version 2020.1 can not borrow a...

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Bug-ReCap registration and alignment with survey point...

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Bug-ReCap auto changes the units back to METERS

26 views • 11 months ago

Class surveys and speaker awards

248-462-5025

Text me! I'm free today from 10:30-1:30pm

- Class surveys
  - Attendees can complete in the AU app or online
  - This year there is a question on quality of class materials (handouts and presentations and/or datasets)
  - Increase your chances of returning as a speaker to AU
  - View results in real-time via the SRC
- Encourage audience to complete – incentives
  - Let your voice be heard and help shape AU 2020
  - Daily drawing for AU 2020 conference pass
- Speaker awards for
  - Top Hands-on Lab, Top Industry Talk/Panel, Top Instructional Demo, Top Roundtable, Rookie of Year, Speaker's Choice, Top Autodesker

I am a Rookie!

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YouTube LINK

- Tim Vetter

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