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Quality Assurance and Data Management for the Inclusion of Residual Stresses

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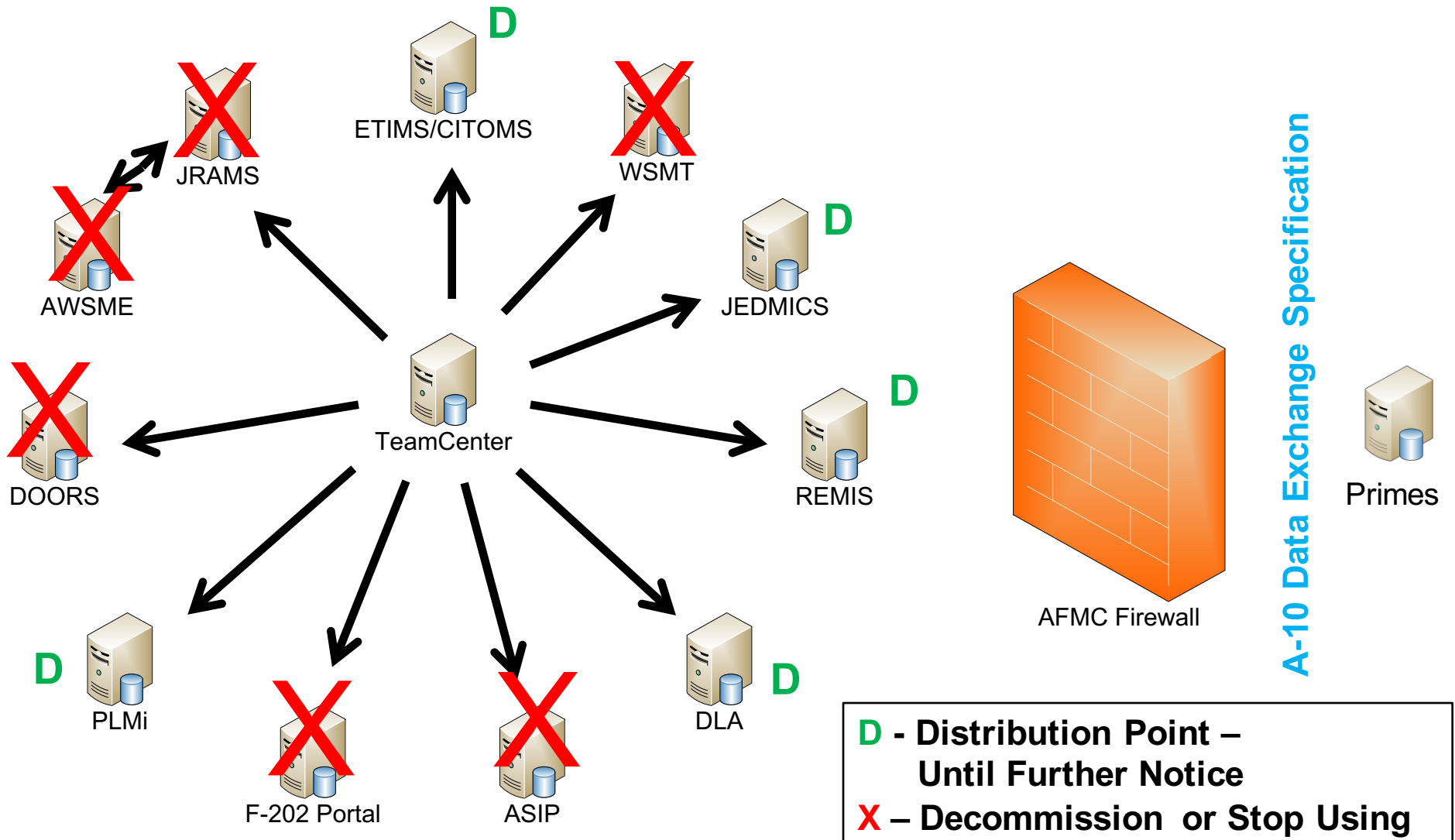
Overview



- **Data management**
 - **A-10 PLM**
 - **MBD structure**
 - **PLM interaction tool (Nlign)**
- **Quality Assurance**
 - **Data capture at the point of maintenance**



A-10 PLM Implementation





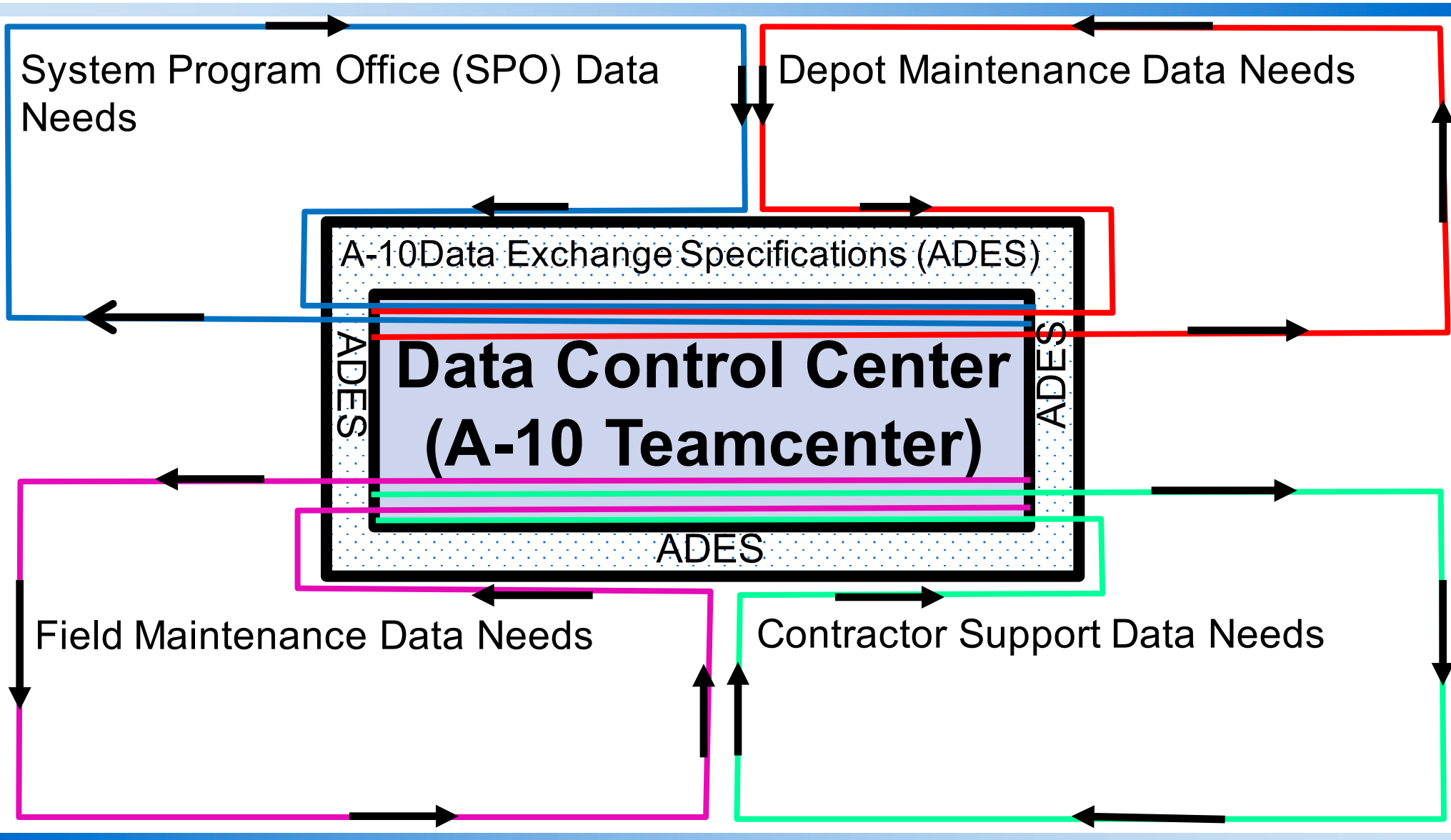
A-10 PLM Implementation



**Teamcenter
as
Single Source
of Truth**

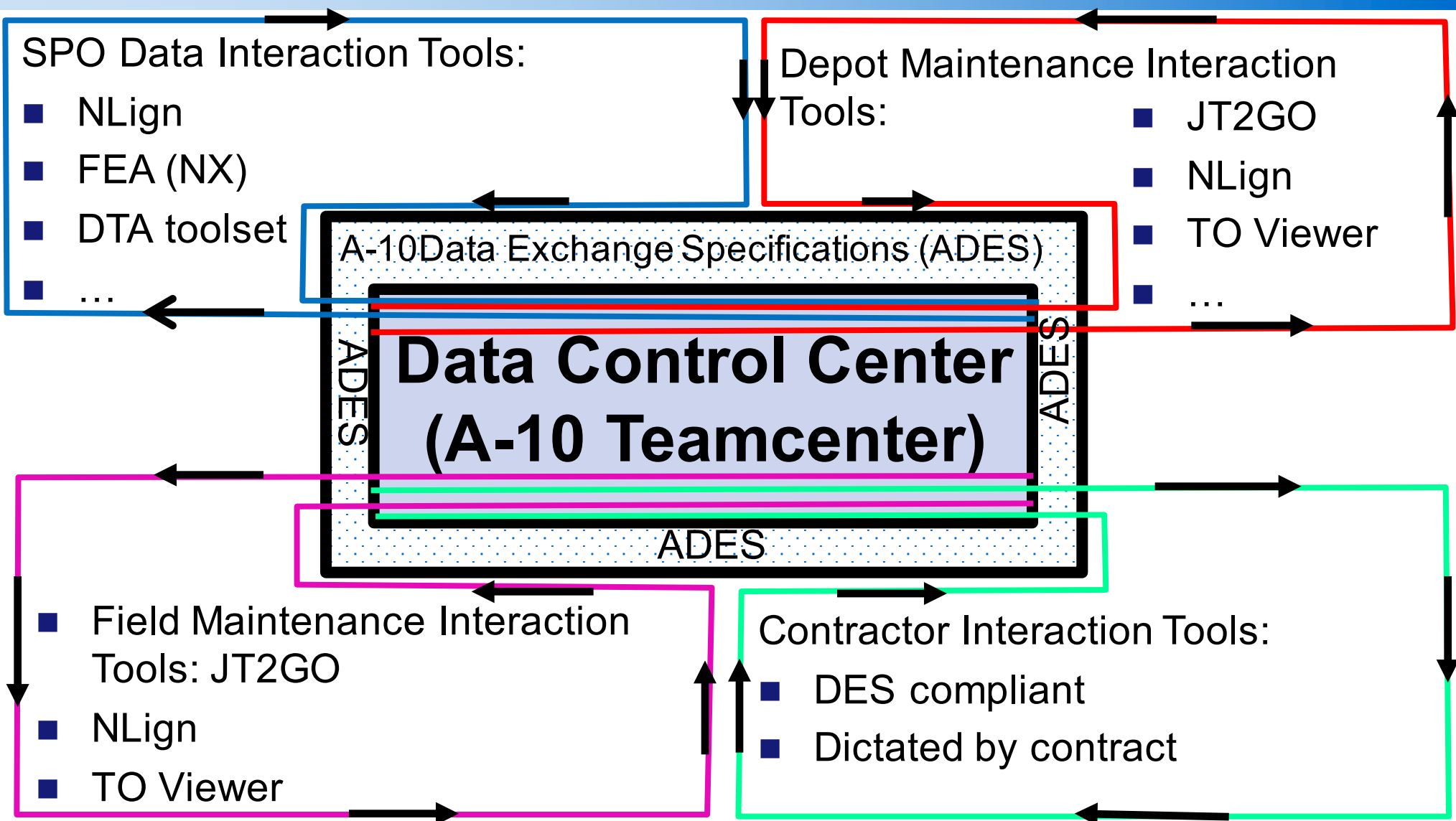


A-10 PLM Implementation





A-10 PLM Implementation



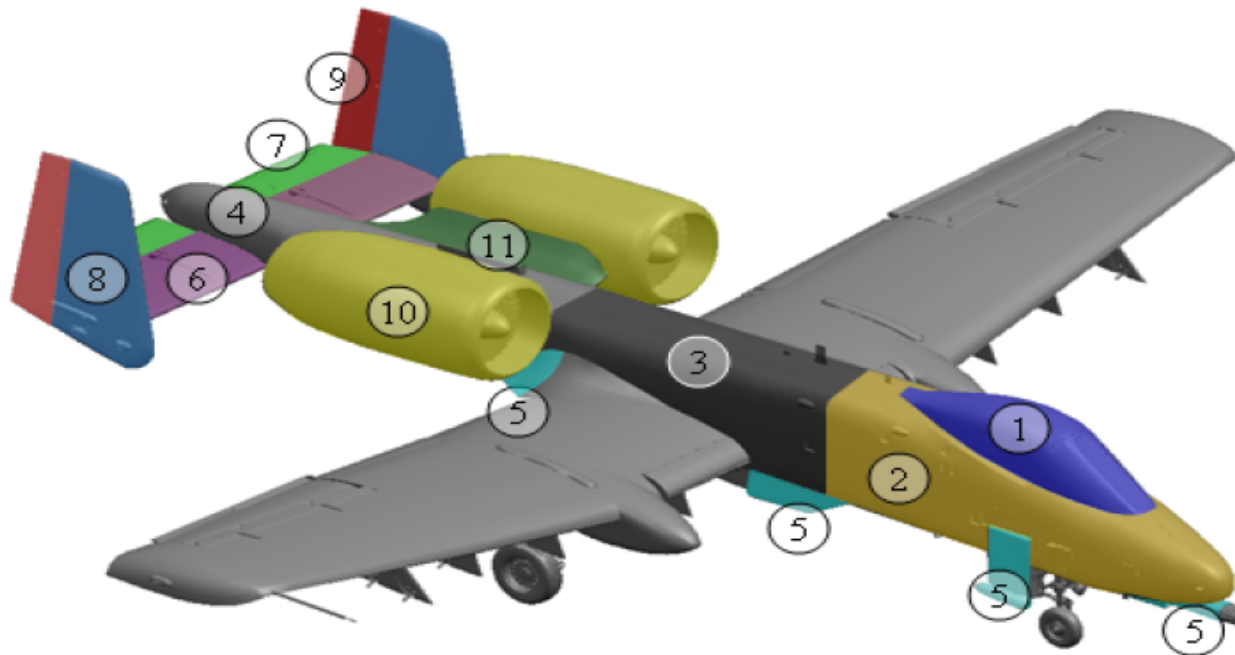


Model Based Definition (MBD)



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- 3D MBD(Legacy & EWA)
 - Data managed under part number effectivity
 - Defined critical inspection locations for data management



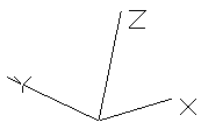
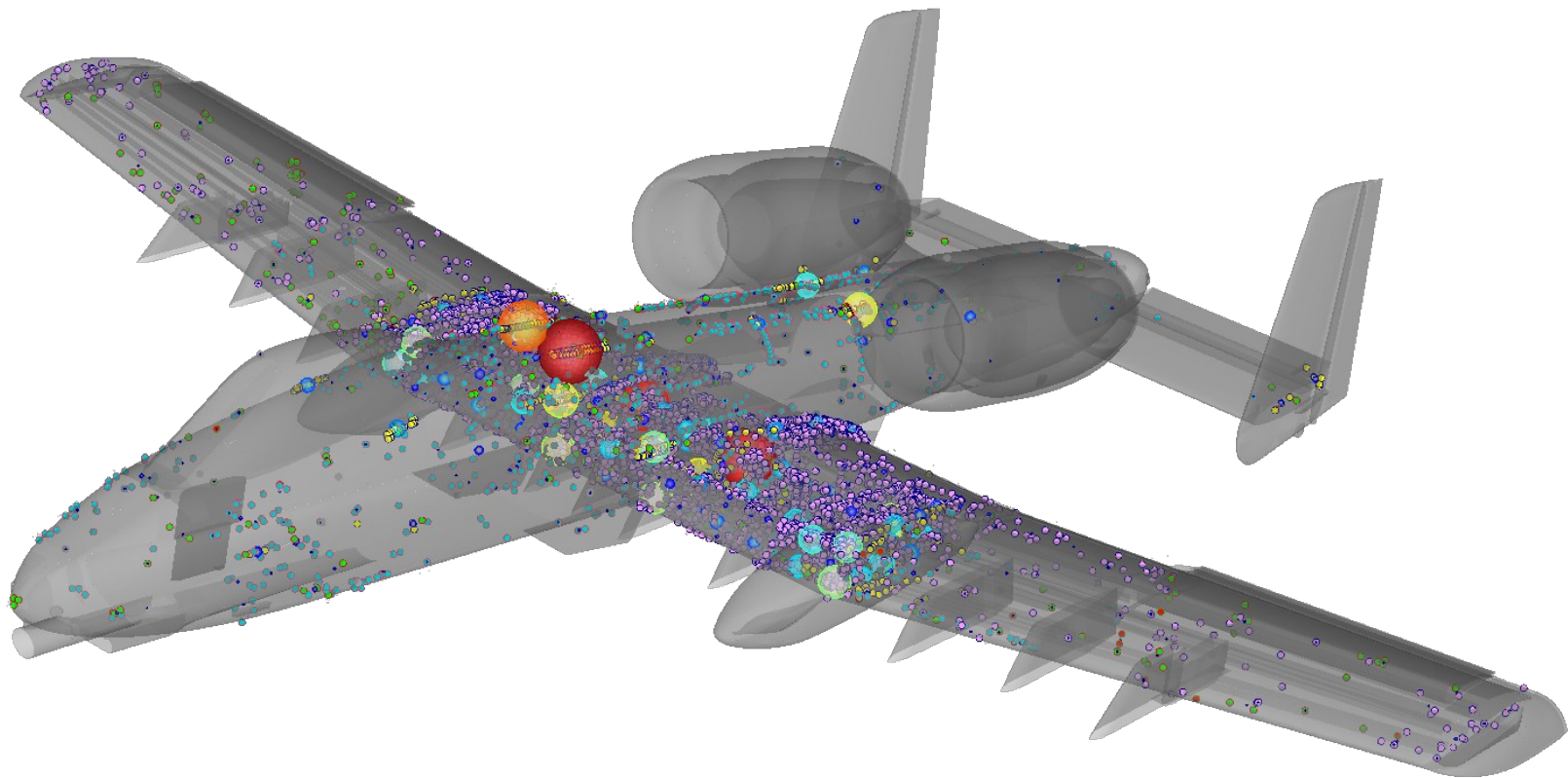


PLM Interaction Tool (NLign)



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- Visual information communication



For Official Use Only



PLM Interaction Tool (NLign)



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Quick data access

The screenshot displays the NLign interface with a 3D model of an aircraft wing. A red box labeled "Metadata" points to the left-hand details panel. Another red box labeled "Live links to controlled Teamcenter Documents" points to the "Teamcenter Links" field at the bottom of the details panel. A third red box labeled "Blend Repair Graphic" points to a document window showing a repair graphic. A fourth red box labeled "Description of Defect Evaluated:" points to a Microsoft Word document window showing defect details and images.

Metadata Panel:

- Description: (2) SCUFF MARKS ON THE 162D611404-2001 RIB ITEM 1: .205 LONG X .230 WIDE X .002 DEEP PART THICKNESS .208 COAT THICKNESS 1.28 MIL LOCATION (X,Y,Z) = (434.62,-66.00,86.01) ITEM 2: .302 LONG X .237 WIDE X .002 DEEP PART THICKNESS
- Attachments: 'D2.pdf' "HMSCAPP - NCM No NCR021781W-009.pdf"
- Location (in): X 434.62 Y -66 Z 86.01
- NCR No: NCR021781W
- Doc Created By: Boeing Production
- Date Document Created: 2011-11-01
- WCP Serial No: FY30-0007
- RH WOP Serial No:
- LH WOP Serial No:
- Station: WS 66;WS 60 - WS 110
- Status: CLOSED
- Assembly Part No: 162D611001-1001
- Assembly Type: Wing Center Panel
- NC Header Part No: 162D611105-55A-0370
- Affected Part Nos: 162D611404-2001
- Affected Part Nomencl: Rib
- Multisite Damage: yes
- Total Defect Count: 2
- Defect Part Quantity: 1
- Boeing Cause Code: ME7

Teamcenter Links:

- Flow Mtdays: 3.4072
- Teamcenter Links: [NCR021781W/01_D9_Teg](#), [NCR021781W_01_Worksheet](#)

Blend Repair Graphic Document:

HMSCAPP%20-%20NCM%20No%20%20NCR021781W-0...

File Edit View Window Help

Open Create Tools Fill & Sign Comment

6 / 7 66.7%

Only Boeing Proprietary Non C

er ID: C380112 Date Added: 02-NOV-2011

Blend Repair Graphic

Description of Defect Evaluated:

IS: (1) DING IN THE RADIUS OF THE 162D611404-2009 TEE. .118 LONG X .049 WIDE X .009 DEEP RADIUS .130 PART THICKNESS .090 COAT THICKNESS 2.42 MIL LOCATION (X,Y,Z) = (409.85,-65.89,70.43) SIB NO DAMAGE CALIPER 74002894 EXP 3/14/12 COAT THICKNESS GAGE 74000471 EXP 3/20/12

11.00 x 8.50 in

Page: 1 of 2 Words: 4/178 80%



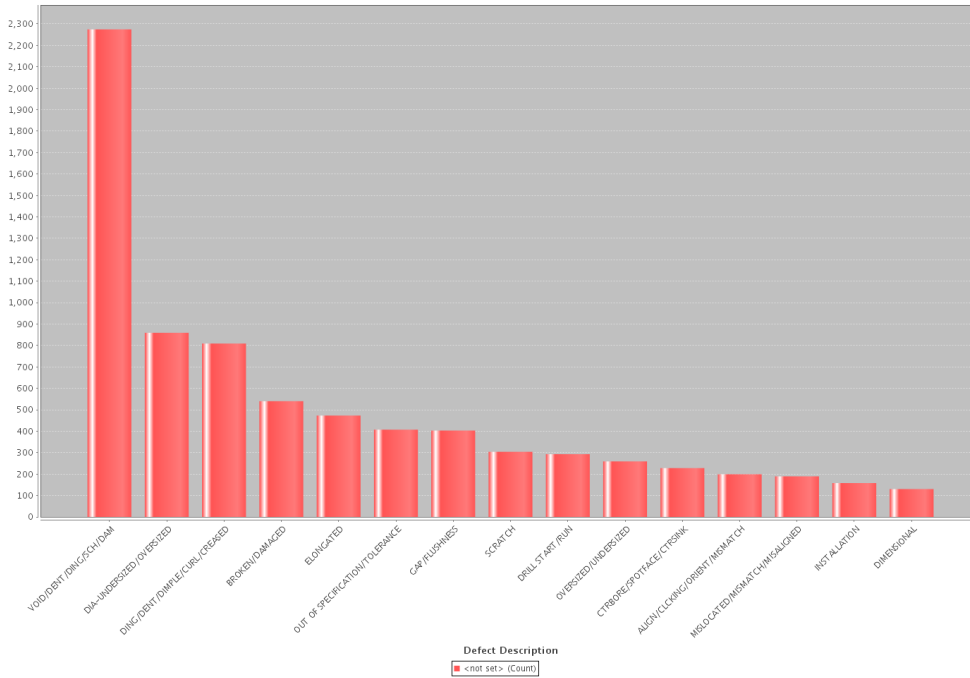
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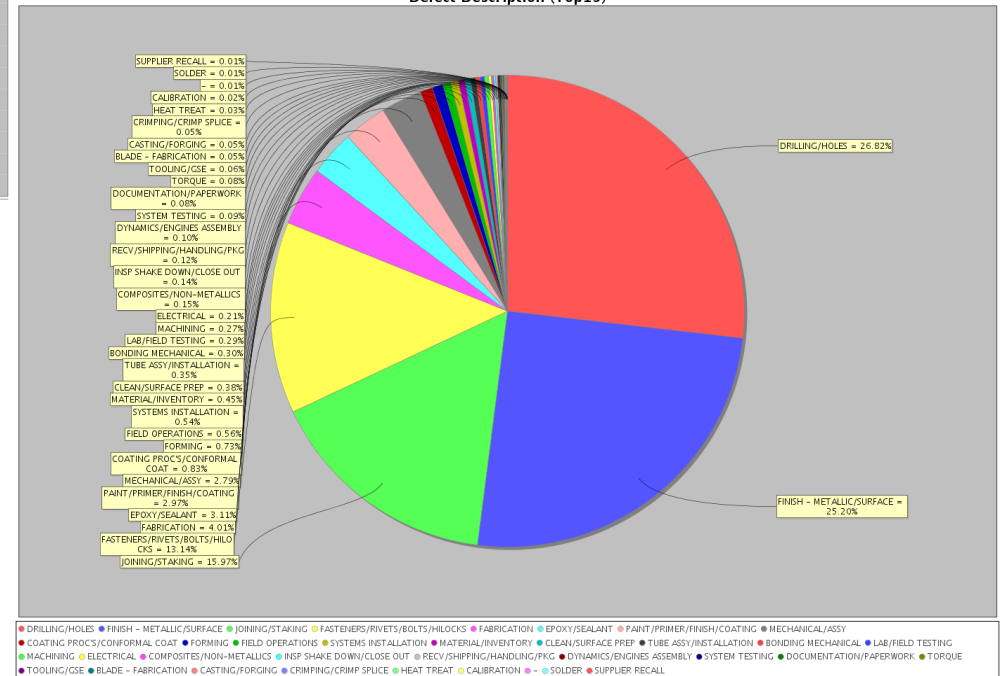
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Live charts to quickly communicate data and feed analysis

Defect Description (Top15)



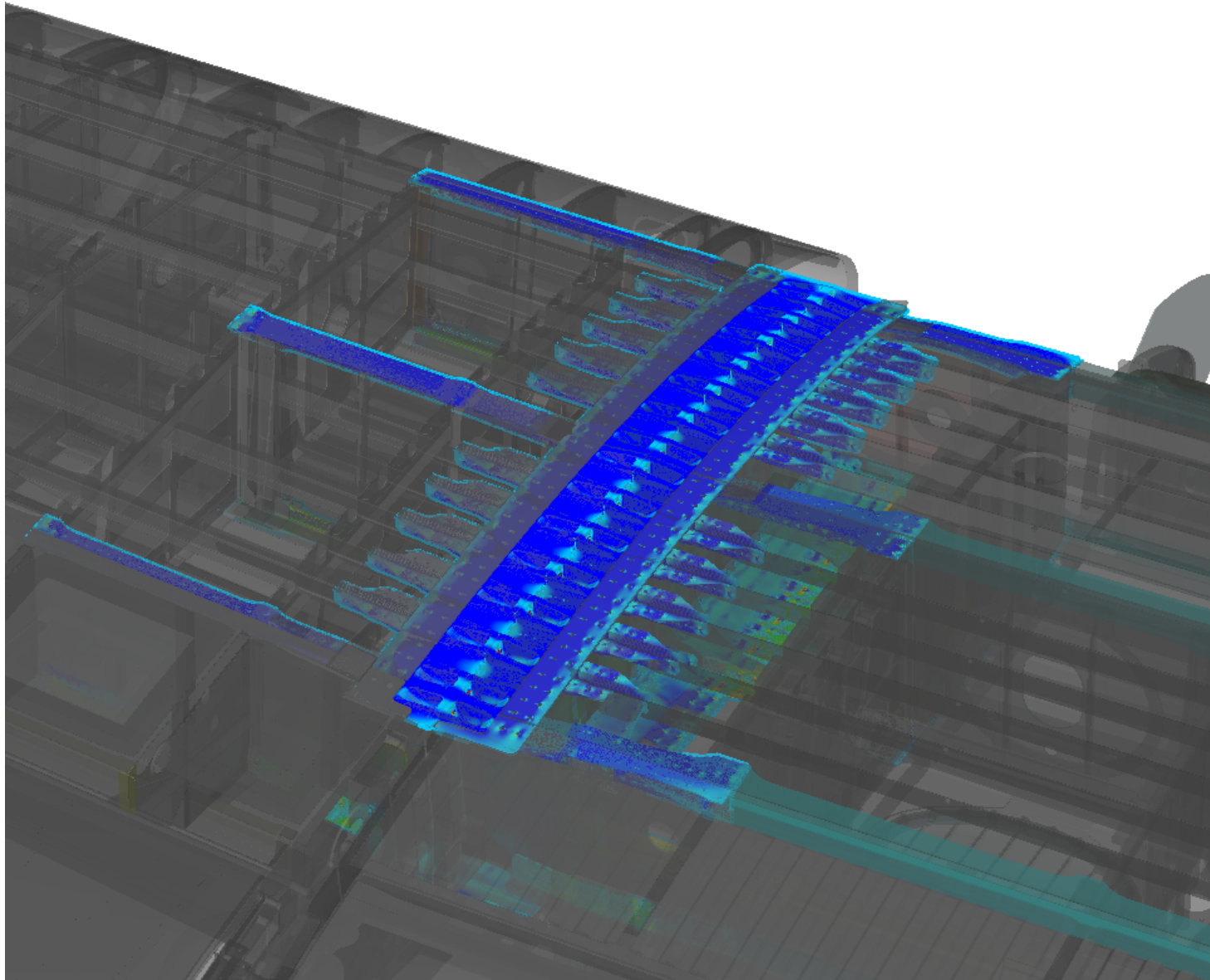
Defect Description (Top15)





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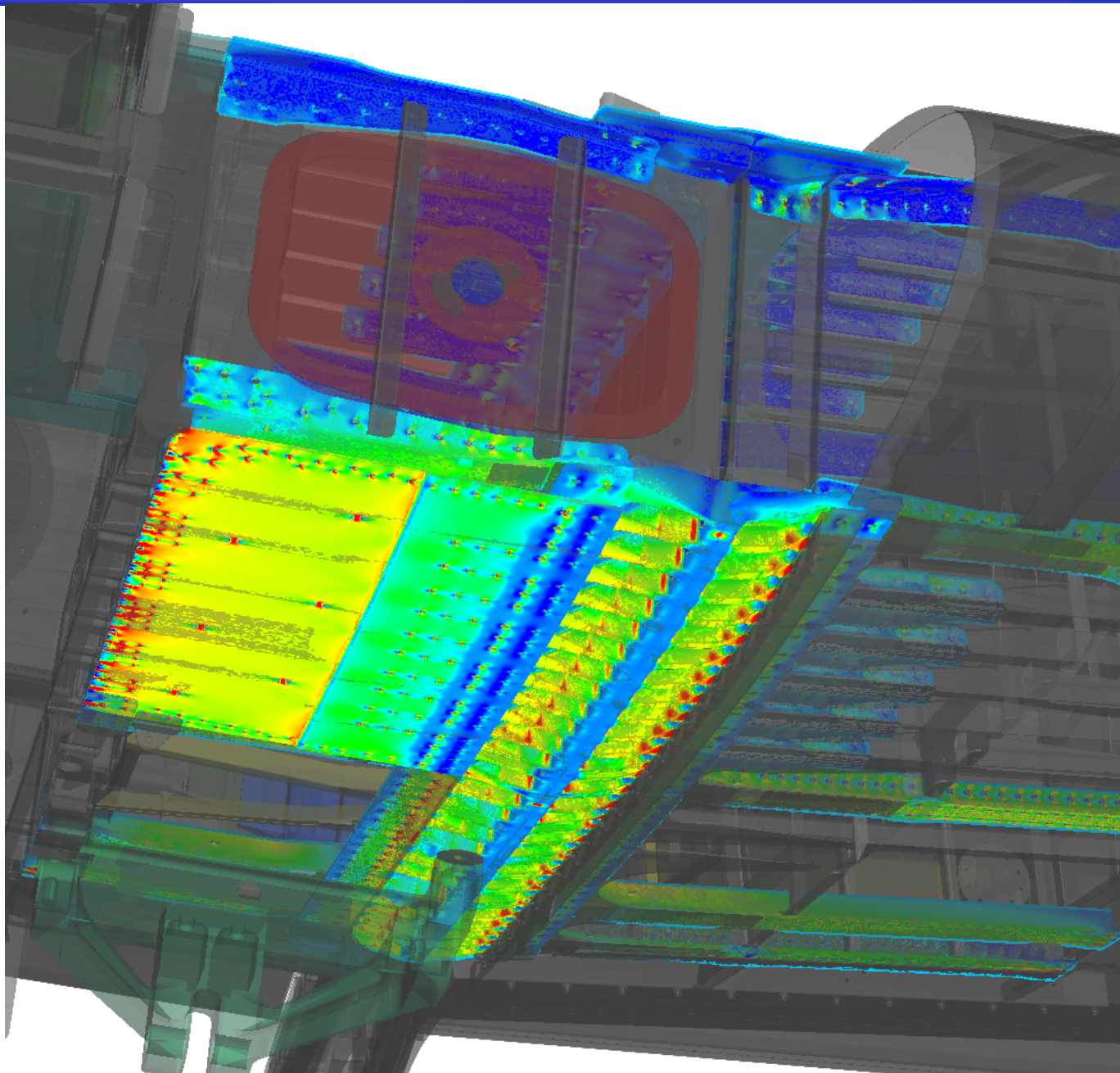
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PLM Interaction Tool (NLign)

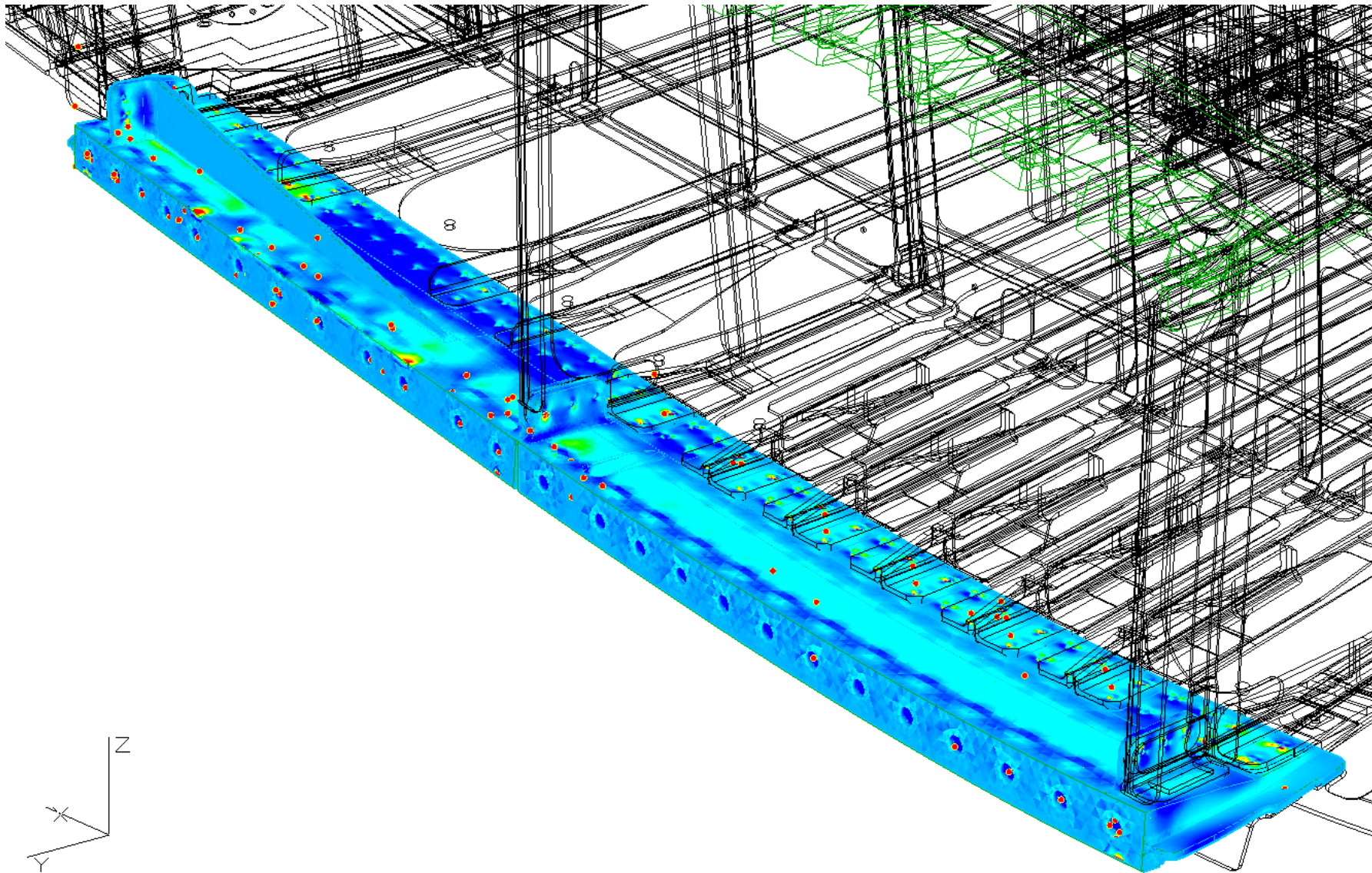




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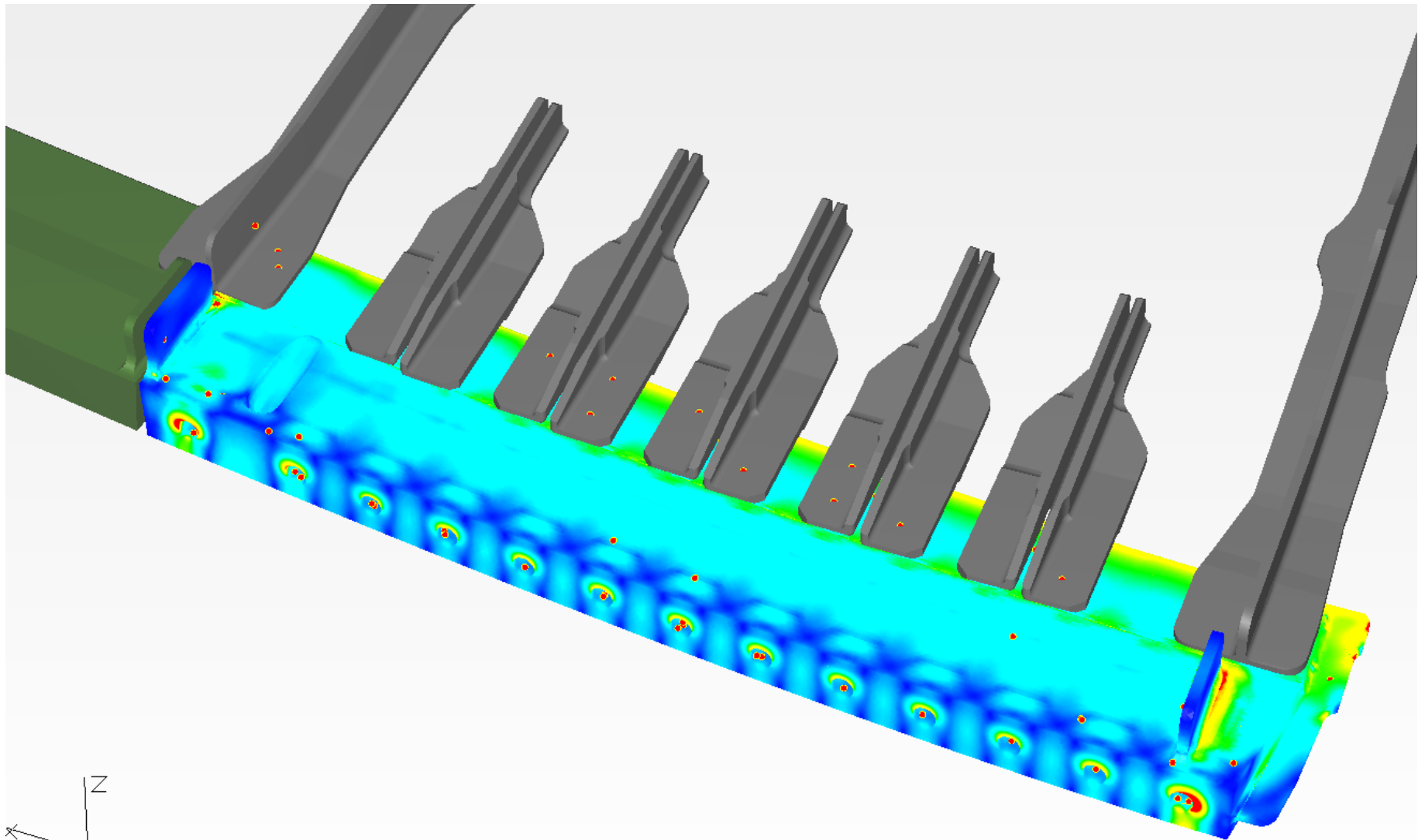




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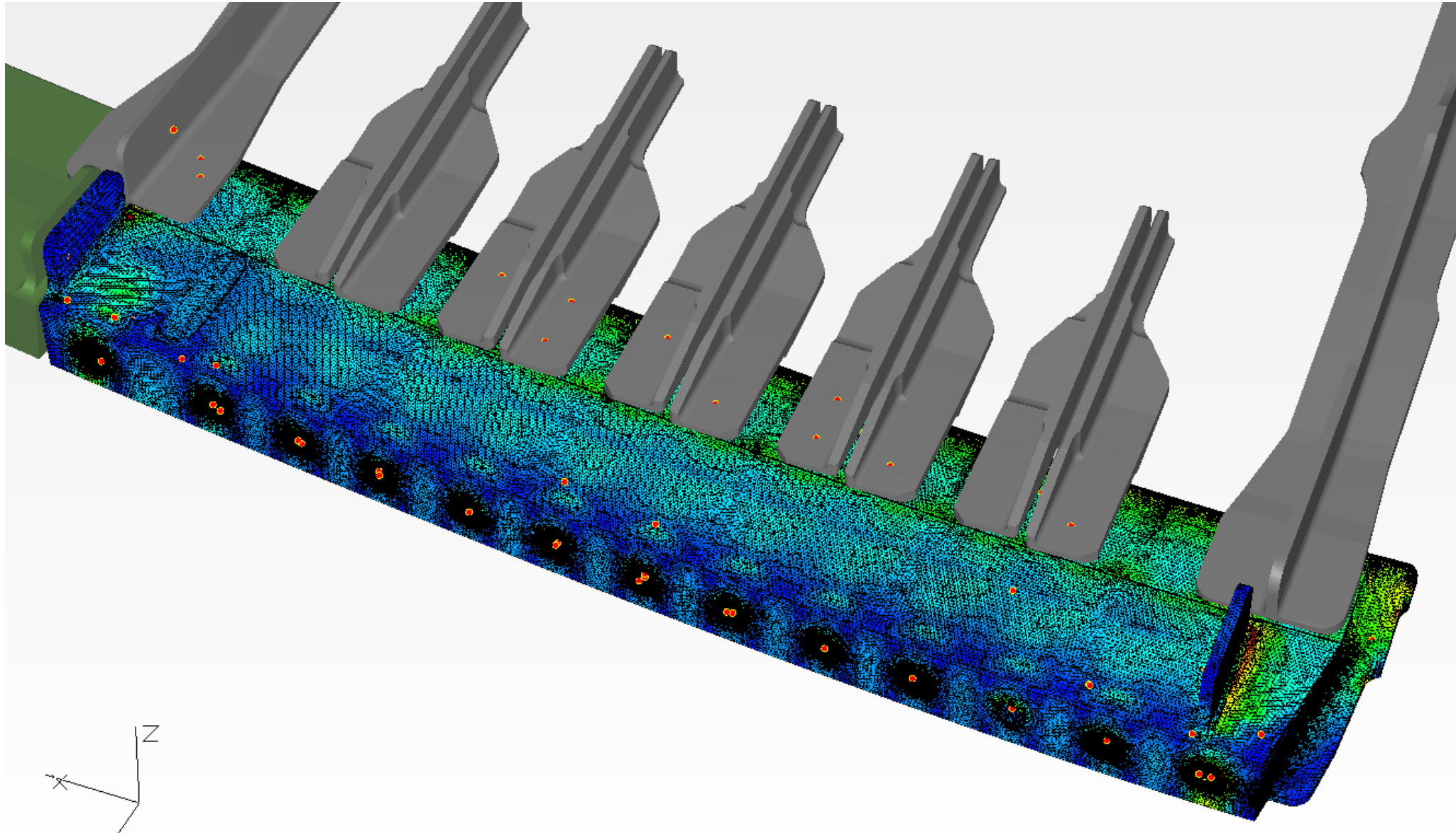




PLM Interaction Tool (NLign)



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PLM Interaction Tool (NLign)



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Clusters
Algorithm: Point Radius Search

Count	X	Y	Z
39	415.187	-114.86	69.063
35	433.45	-110.067	69.499
26	410.393	-110.102	68.234
21	423.858	-110.047	68.511
19	418.433	-110.072	67.941
15	429.151	-110.048	68.936
14	413.543	-110.059	68.375
8	419.979	-114.698	69.29
7	426.617	-115.123	69.857
6	431.518	-114.702	70.379
4	435.446	-110.13	70.809
3	435.766	-115.166	71.216
2	421.211	-110.351	69.245
1	423.271	-114.866	69.539
1	407.828	-114.19	68.477

Showing 15 of 15 clusters. Isolate Selection

Display Settings

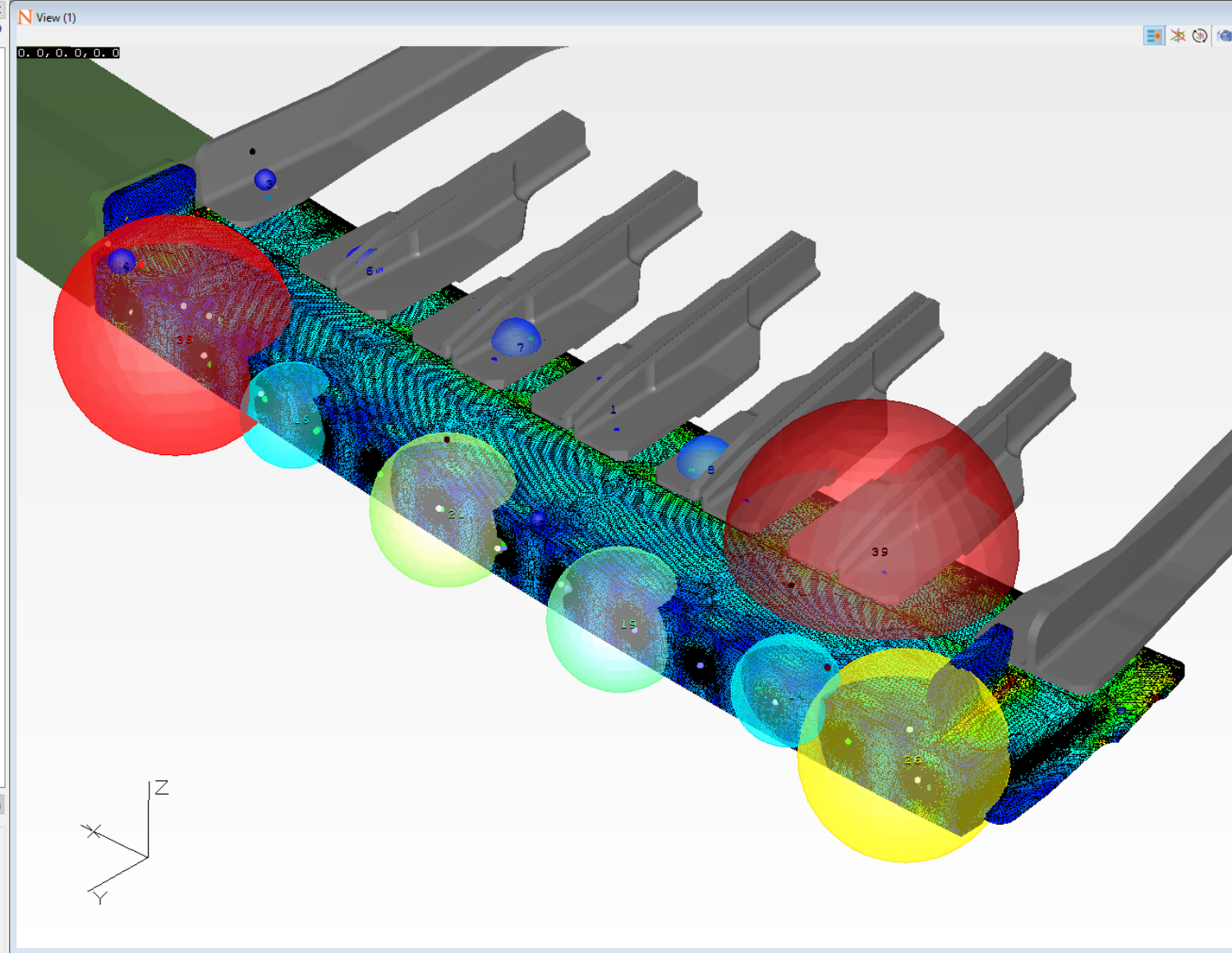
Radius:

Scale: Auto

Member Threshold:

Show Counts:

Show Member Lines:





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PLM Interaction Tool (NLign)



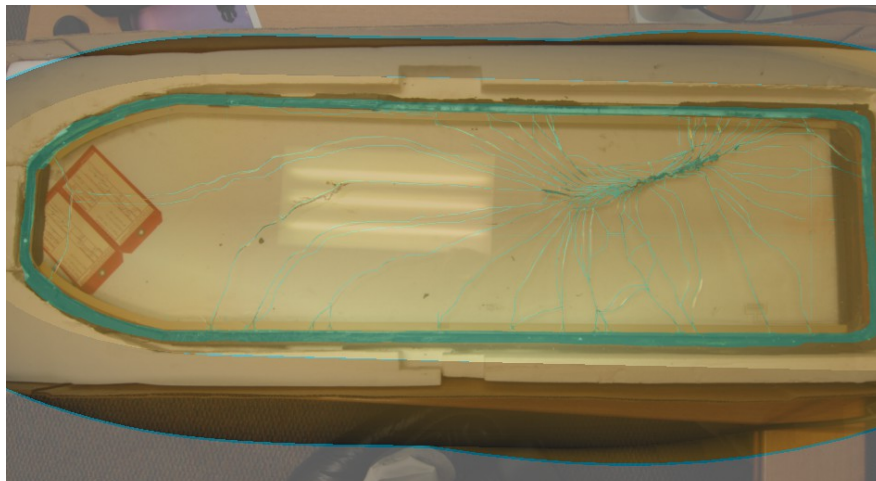
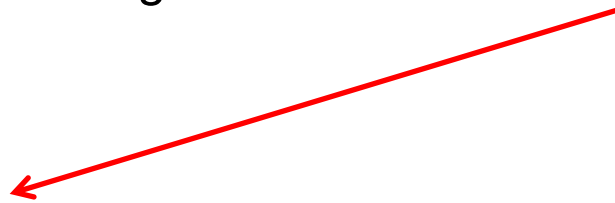
Photo of Damage



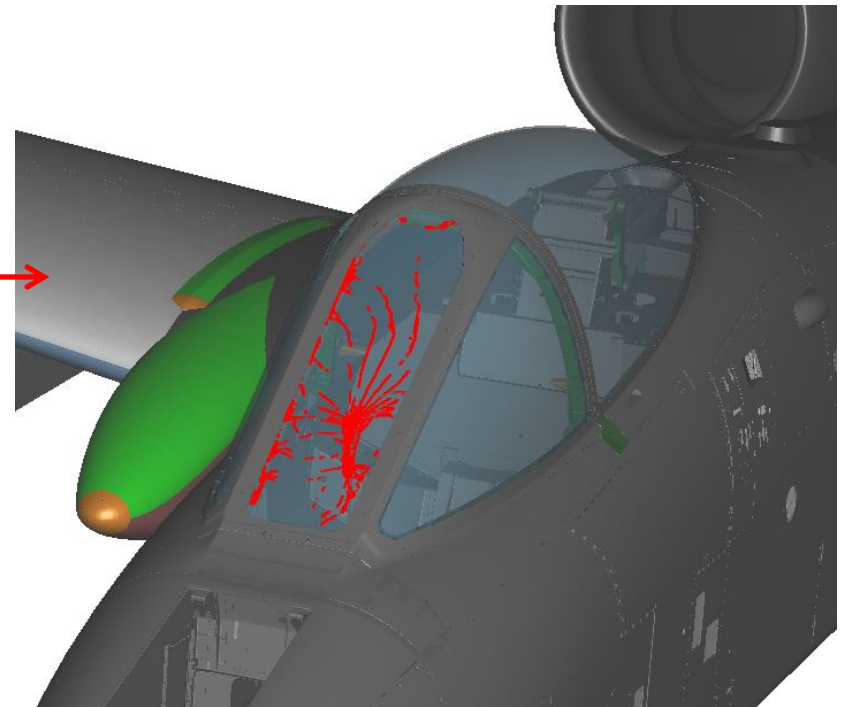
Photo alignment to Model



Photo Enhancements to amplify damaged regions



Damaged Mapped on Model for Trending

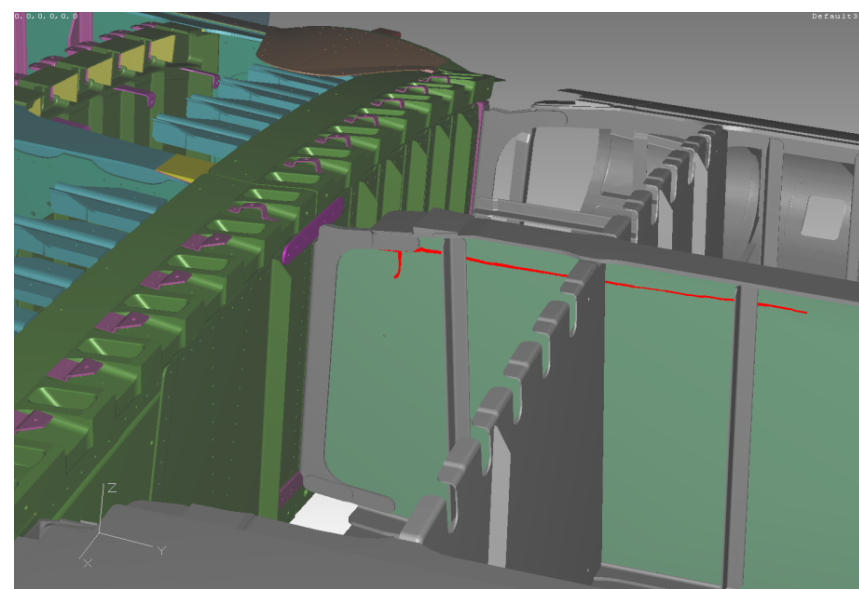
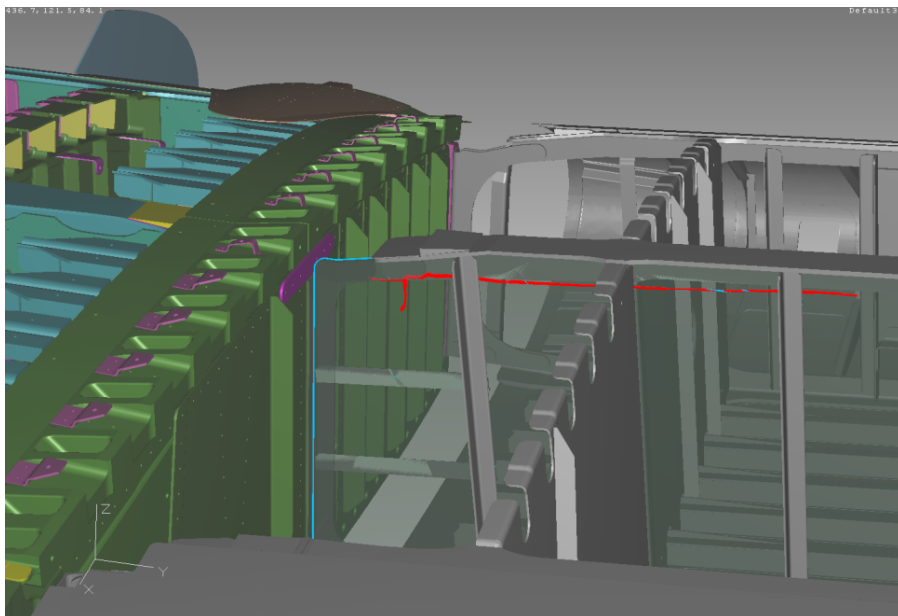
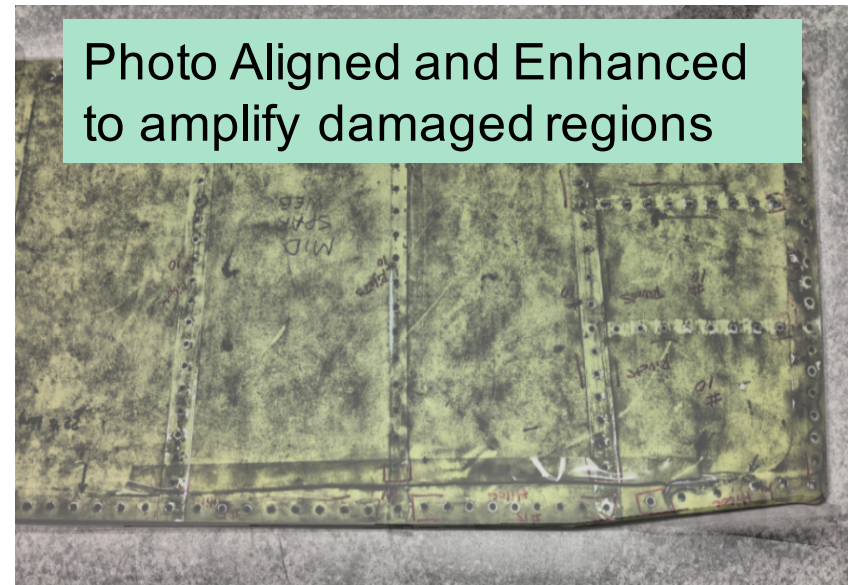
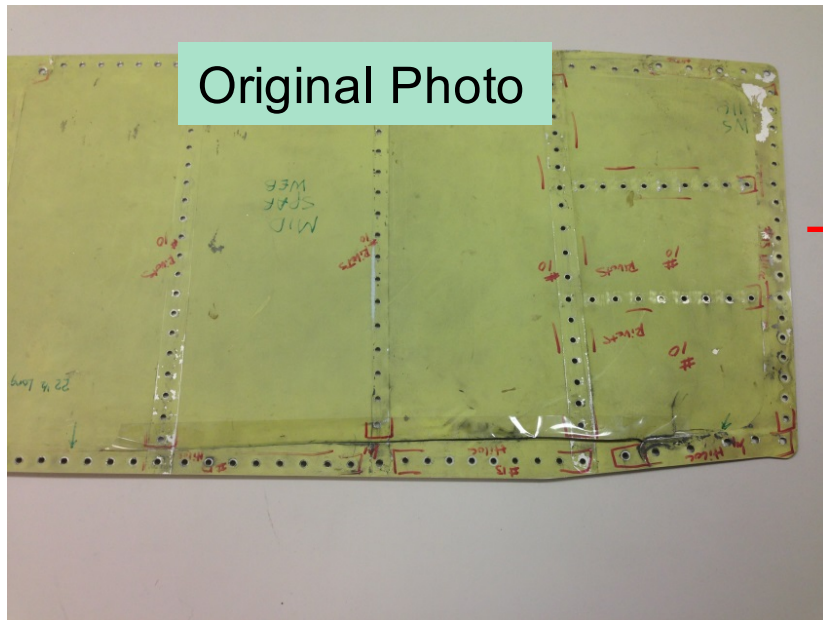




PLM Interaction Tool (NLign)



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Quality Assurance



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Data Capture at the Point of Maintenance



- A-10 Scheduled Structural Inspection (SSI) program.
 - Historically it takes 7-9 months from the asset induction date before Engineering sees SSI data
 - Low quality
 - No ability for engineering to address data issues while the asset is open and accessible
 - Usually asset is back on an aircraft and ready for service when the maintenance data is received
 - Engineer Tech required to manually input data into database



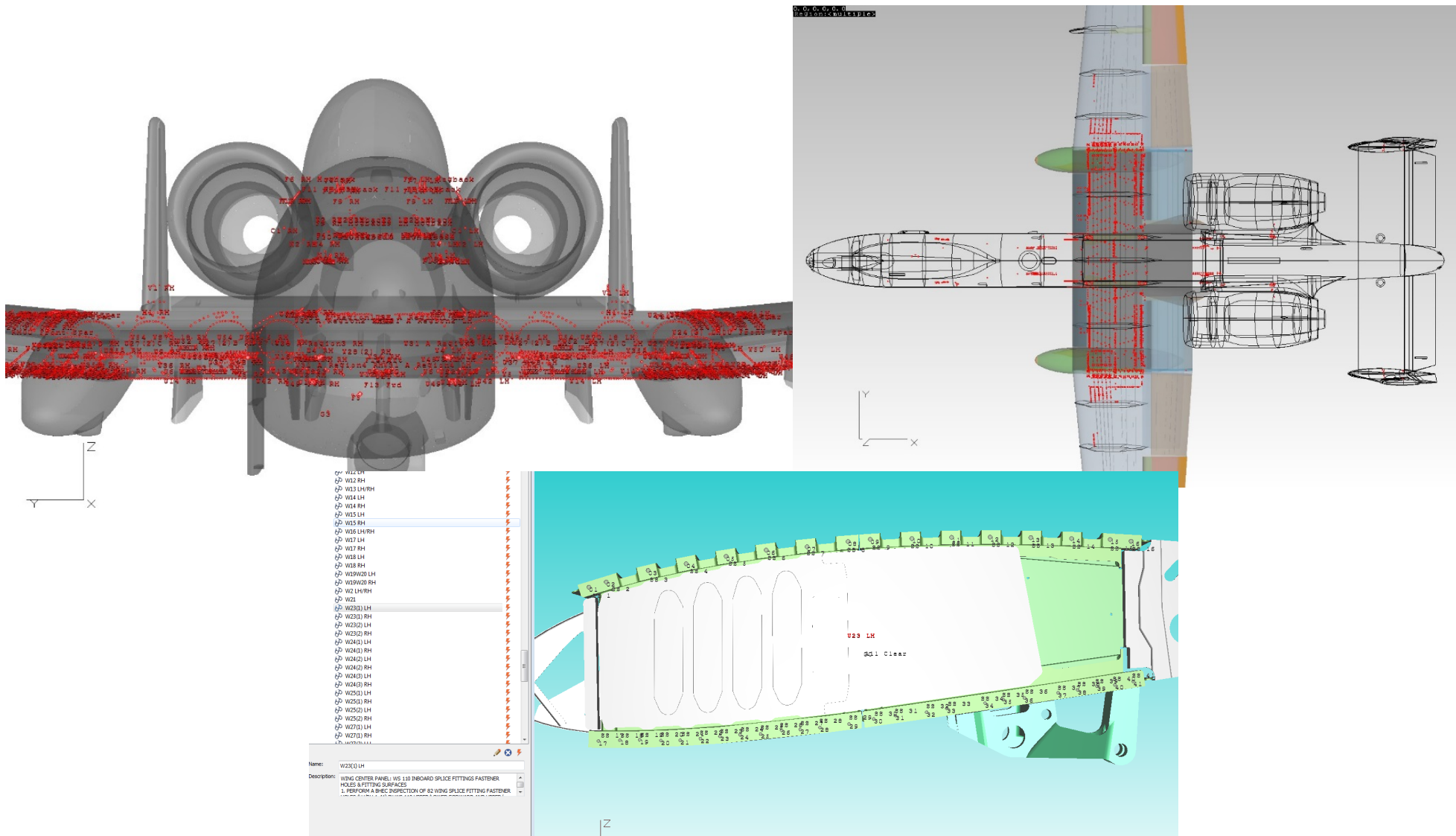


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Data Capture at the Point of Maintenance



3D framework for quick and accurate digital inspection input





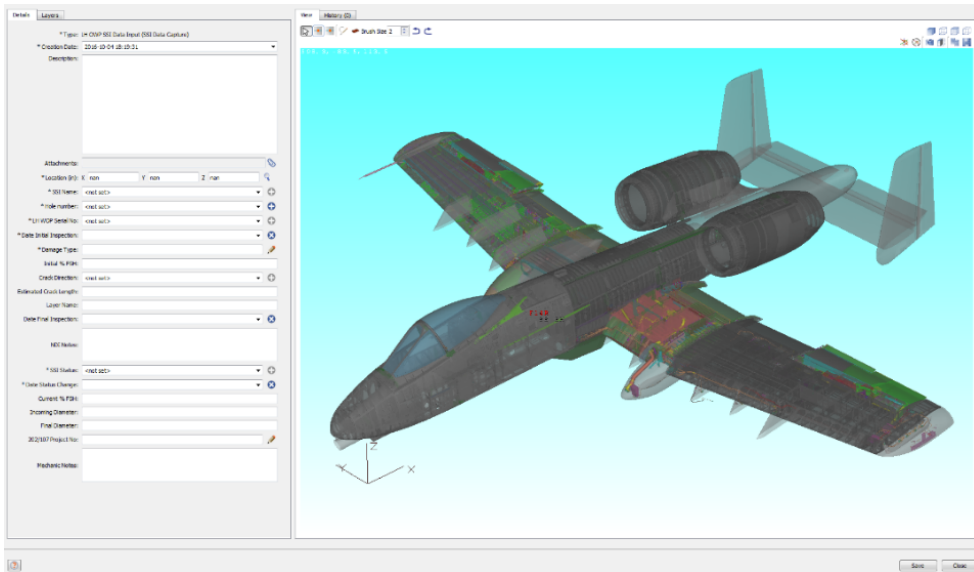
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Data Capture at the Point of Maintenance



- Aug-Sept 2016 NLogn data collection test.
- Customized NLogn data capture trendable per SN component type
- Developed quick 'at a glance' reporting tool
 - Keep supervisors informed
 - Keep NDI tech and Mechanic in sync to work remaining

Data input screen



Coordination Report

	A	B	C	D	E	F	G
	RH WOP Serial No	LH WOP Serial No	SSI Name	Hole number	SSI Status	Creation Date	Date Status Change
1							
2		00B6200627L	W50 LH	1	Complete	9/6/2016 12:29	9/6/2016
3		00B6200627L	W33R LH	SS Web	Complete	9/6/2016 9:22	9/6/2016
4		00B6200627L	W54 WS42.5 LH	1	Complete	9/6/2016 9:22	9/6/2016
5		00B6200627L	W54 WS42.5 LH	1	Complete	9/6/2016 9:22	9/6/2016
6		00B6200627L	W29 LH	SS	Complete	9/6/2016 9:03	9/6/2016
7		00B6200627L	W29 LH	SS	Complete	9/6/2016 9:03	9/6/2016
8		00B6200627L	W25(1) S11 RH	3	Complete	8/31/2016 10:27	8/31/2016
9		00B6200627L	W23(2) LH	1	Complete	8/31/2016 9:01	8/31/2016
10		00B6200627L	W25(2) OS11 LH	3	Complete	8/31/2016 9:01	8/31/2016
11		00B6200627L	W24(3) OS2 LH	2	Complete	8/30/2016 13:24	8/31/2016
12		00B6200627L	W24(3) LHOU Center Spar	7	Complete	8/30/2016 13:24	8/31/2016
13		00B6200627L	W24(3) LHOU Center Spar	5	Complete	8/30/2016 13:24	8/30/2016
14		00B6200627L	W24(3) LHOU Center Spar	4	Complete	8/30/2016 13:24	8/31/2016
15		00B6200627L	W24(3) OS7 LH	7	Complete	8/30/2016 13:24	8/31/2016
16		00B6200627L	W24(3) OS7 LH	6	Complete	8/30/2016 13:24	8/31/2016
17		00B6200627L	W24(3) OS7 LH	1	Complete	8/30/2016 13:24	8/31/2016
18		00B6200627L	W24(3) LHOU Rear Spar	1	Complete	8/30/2016 13:24	8/31/2016
19		00B6200627L	W24(2) OS15 RH	7	Complete	8/30/2016 10:44	8/30/2016
20		00B6200627L	W24(2) OS15 RH	7	Complete	8/30/2016 10:44	8/31/2016
21		00B6200627L	W24(2) OS15 RH	7	Complete	8/30/2016 10:44	8/31/2016
22		00B6200627L	W24(2) OS15 RH	7	Complete	8/30/2016 10:44	8/30/2016
23		00B6200627L	W24(2) OS12 LH	2	Complete	8/30/2016 10:44	8/30/2016
24		00B6200627L	W24(2) OS14 LH	1	Complete	8/30/2016 10:44	8/30/2016
25		00B6200627L	W45 LH	1	Complete	8/30/2016 10:44	8/30/2016
26		00B6200627L	W19W20 LH	11	Complete	8/30/2016 9:40	8/30/2016



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Data Capture at the Point of Maintenance



Historic SSI Data Capture Process



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Low Quality

VS.

Digital data capture with NLign

- OWP 2016 test:
 - 3 weeks to complete with 100% data accuracy
 - Data available to engineers ~ 800% faster
- CWP 2017 = 2.5 months to complete with 100% data accuracy
 - Data available to engineers ~ 500% faster
- 2018 full implementation of NLign on shop floor.



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Data Capture at the Point of Maintenance



← Back 1. SSI Finding × + NLIgn NSpector — □

Location Files View Comments (0)

+ Add Camera Screenshot | Create Grid Open Download Edit Delete

1. Location X,Y,Z (in.):
262.632, -20.926, 120.658

2. Layer Name: _____

3. Incoming Diameter: _____

4. Final Diameter: _____

5. Estimated Crack Length: _____

6. Initial % FSH: _____

7. Current % FSH: _____

265 Rotation View 3 of 5 ThicknessGrid.png File 2 of 2

Cell Size: 0.25 in.; Max Thickness: 0.3 in.; Area: 1.12 sq. in.
265.4, -21.4, 120.2



Data Spatial Positioning (DSP) System (RIF)



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PEO FB/AFLCMC/LG-LZ

Requirement #: USAF-18-PEO-FB-9.K

Title: Maintenance Data Spatial Positioning (DSP) System

Military System or Acquisition Customer: Aviation Platforms - All Platforms

Description: Seeking the development of a maintenance DSP technology to provide real-time location feedback to maintainers, capture any maintenance tool data output, and communicate that data for condition-based aircraft management. This technology is building upon previous RIF efforts focused on data communication and analytics with the NLign tool, to enable a highly-effective, condition-based maintenance (CBM+) program. Venders should propose and develop the methodology, technology, and hardware for a basic spatial point locating tool, capable of capturing and associating that data to a user-defined airframe coordinate system (X,Y,Z or FS,WL,BL). Additionally, venders should propose and develop the methodology, technology, and hardware for incorporating the DSP system with existing maintenance non-destruction inspection (NDI) tools and cold expansion tools. Leveraging the NLign system from previous RIF efforts, the data positioning system will have the option to utilize pre-defined maintenance locations and provide feedback to the maintainer for location compliance. Any data output from maintenance tools should be captured with spatial coordinates and communicated to the NLign system for analysis. This tool is intended for depot or field use and to be quickly adaptable for all airframes. This effort will enhance maintenance data quality for all platforms and reduce the risk of mis-locating or missing critical maintenance operations. Also, this tool will provide the missing verification and high-fidelity data needed in CBM+ to reduce serious risk concerns that have hindered the ability to apply 'game changing' fleet management strategies such as residual stress benefits.

Technical POC: Hazen Sedgwick, Hazen.Sedgwick@us.af.mil (801) 586-0346, or Luke Bracken, luke.bracken@us.af.mil (801) 586-1861



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Questions?

