



Aircraft Management and Sustainment Using NDI Data Trending and Mapping Technologies

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**(1) AFRL – Materials and Manufacturing
Directorate**

(2) Ogden Air Logistics Complex

(3) Etegent Technologies



Outline



- Introduction
 - Background/Benefits
- NDI data management efforts
- NLight NDI data management software
 - Architecture
 - Examples
 - USAF
 - Commercial
- Future Directions
- Conclusions



Introduction



- Background
 - Aging fleets require more data to manage risk & costs
 - More NDI systems began to collect digital data
 - Ultrasound
 - Eddy Current
 - Radiography
 - Shearography
 - NDI processes didn't change
- Motivation from Engineering
 - Get more information from NDI data
 - Investigate concepts to assist in fleet management



Benefits



- Digital NDI data enables automated processing
 - Algorithms can be developed in background
 - Little input from engineering and little effect on maintenance
- Improve overall manufacturing and maintenance process control
 - Automate manual reporting procedures
- Improved analysis tools for engineers
 - Coverage Verification
 - Trending
 - Comparison
 - Reporting
 - Computational



NDI Data Management Efforts



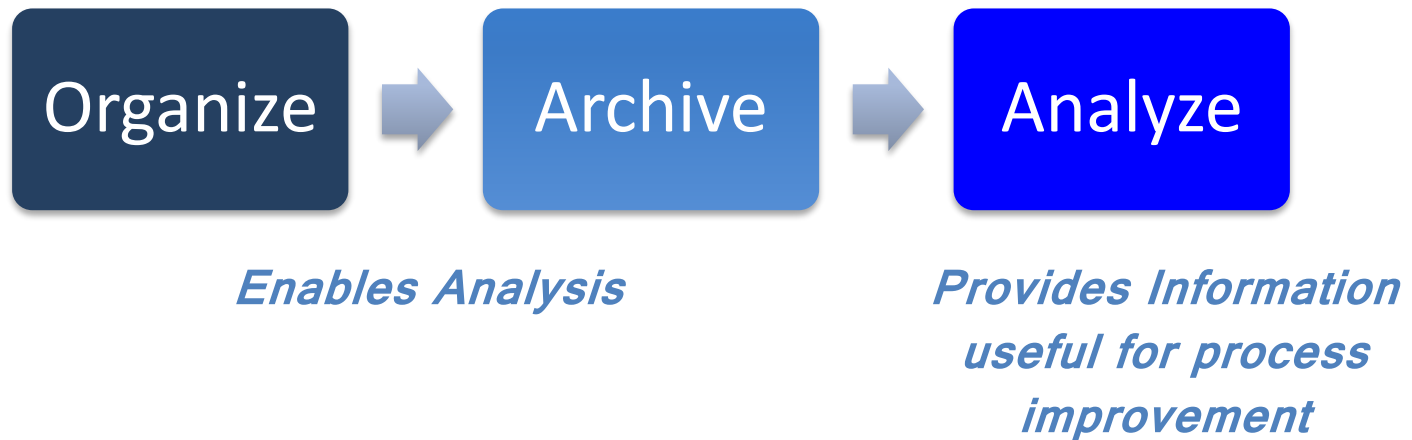
- Program
 - SBIR-II established in 2007 with Etegent Technologies
 - Augmented with ManTech, CPP, Rapid Innovation Funds
- Technical
 - Align inspection data to a CAD-like model of structure
 - Enables a wide variety of analyses not previously achievable
 - Develop NDI data archive capability
 - Process data for customized engineering analysis
 - Implement software on USAF IT network
 - Facilitate communication between maintainers and engineers



NDI Data Management



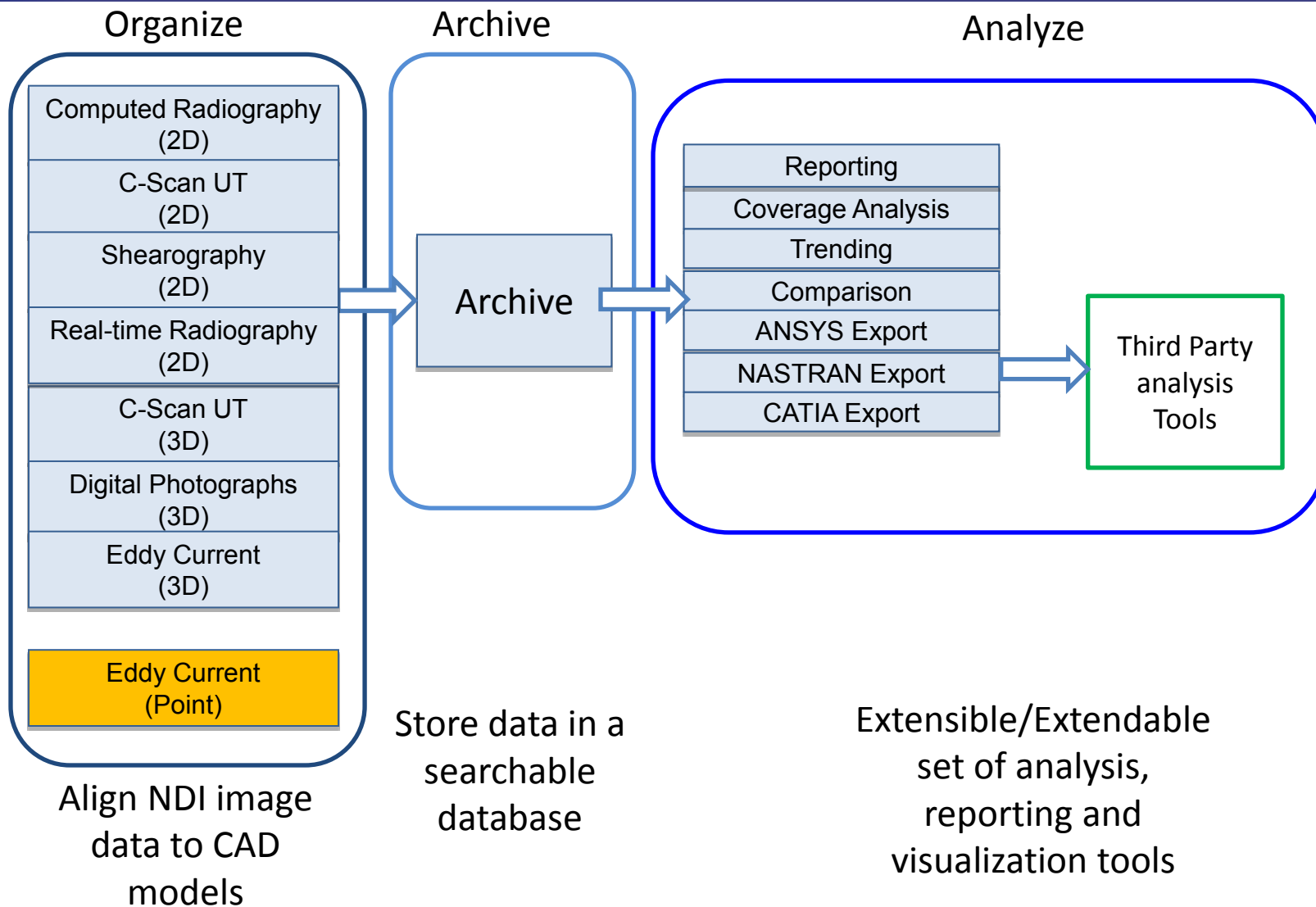
- What do we mean by Inspection Data Management?



- Develop software called NLink by Etegent Technologies to automatically carry out these functions



NLign System Overview





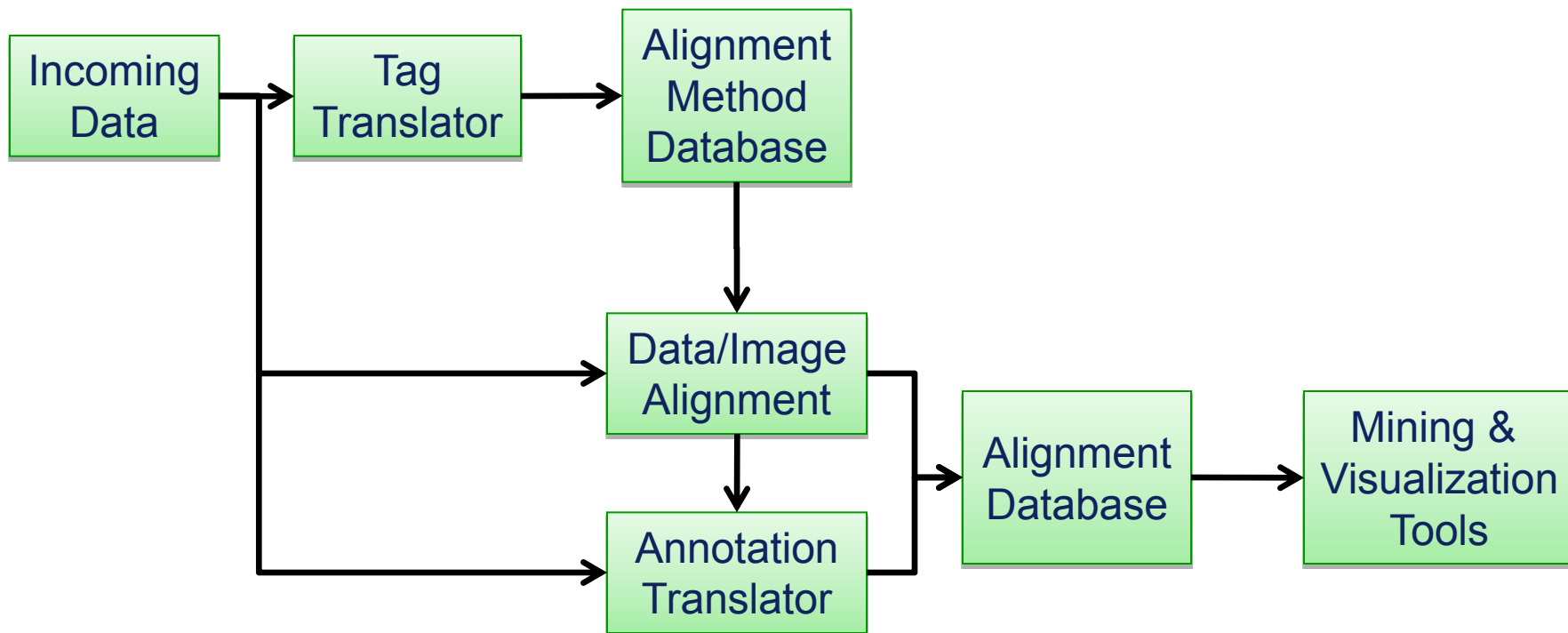
NLign Technical Overview



- Goal was to develop robust framework to organize inspection data
 - Use of open file formats
- NDI data comes in many conditions
 - Data not consistently aligned to part
 - Single image scan/Multiple image scan
 - No overlap/Overlap
 - Non-image information e.g. text, annotations
 - Clear features/No clear features
 - Wide range of “distortions” in the image data
- One approach will not handle all inspection data



NLign System Architecture





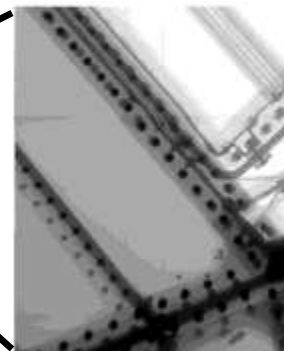
Example 2D Alignment



Image To Be Aligned

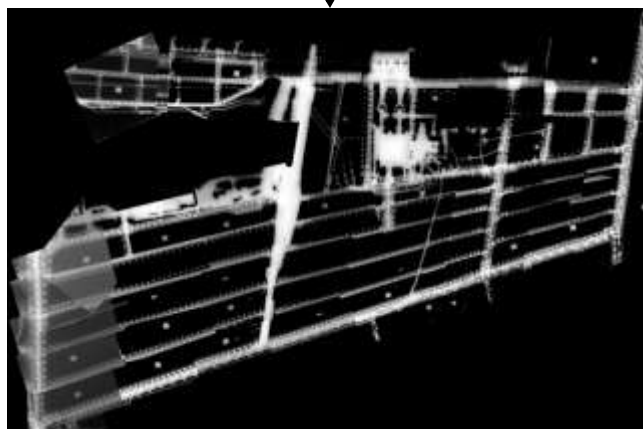


Reference Image



Correlation Based Image Registration

Apply Reference Alignment



Multiple Aligned Images



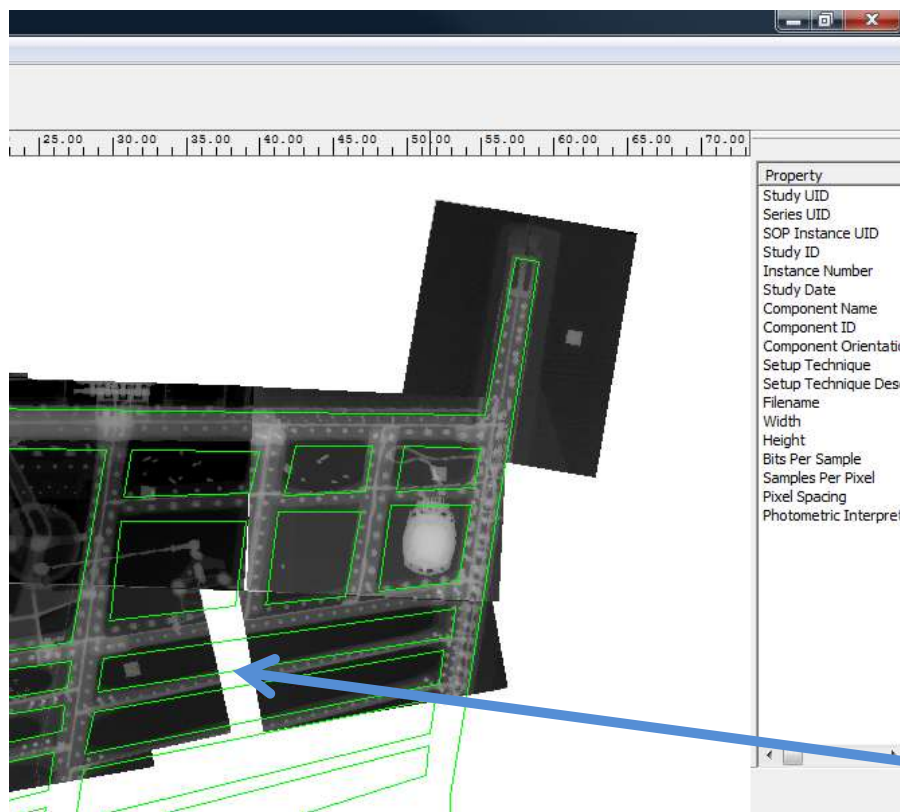
NLign Capability Summary



- Data organized by alignment to CAD
 - Alignment is automated
 - Alignment to CAD enables multiple types of analysis
- Analysis Capabilities
 - Coverage Verification
 - Trending & Comparison
 - Communication between maintainers and engineers
 - Export to analysis packages
 - Queuing former repairs/maintenance
- Feed into both manufacturing and maintenance process improvement efforts
- Independent of weapon system



Analysis – Coverage Verification

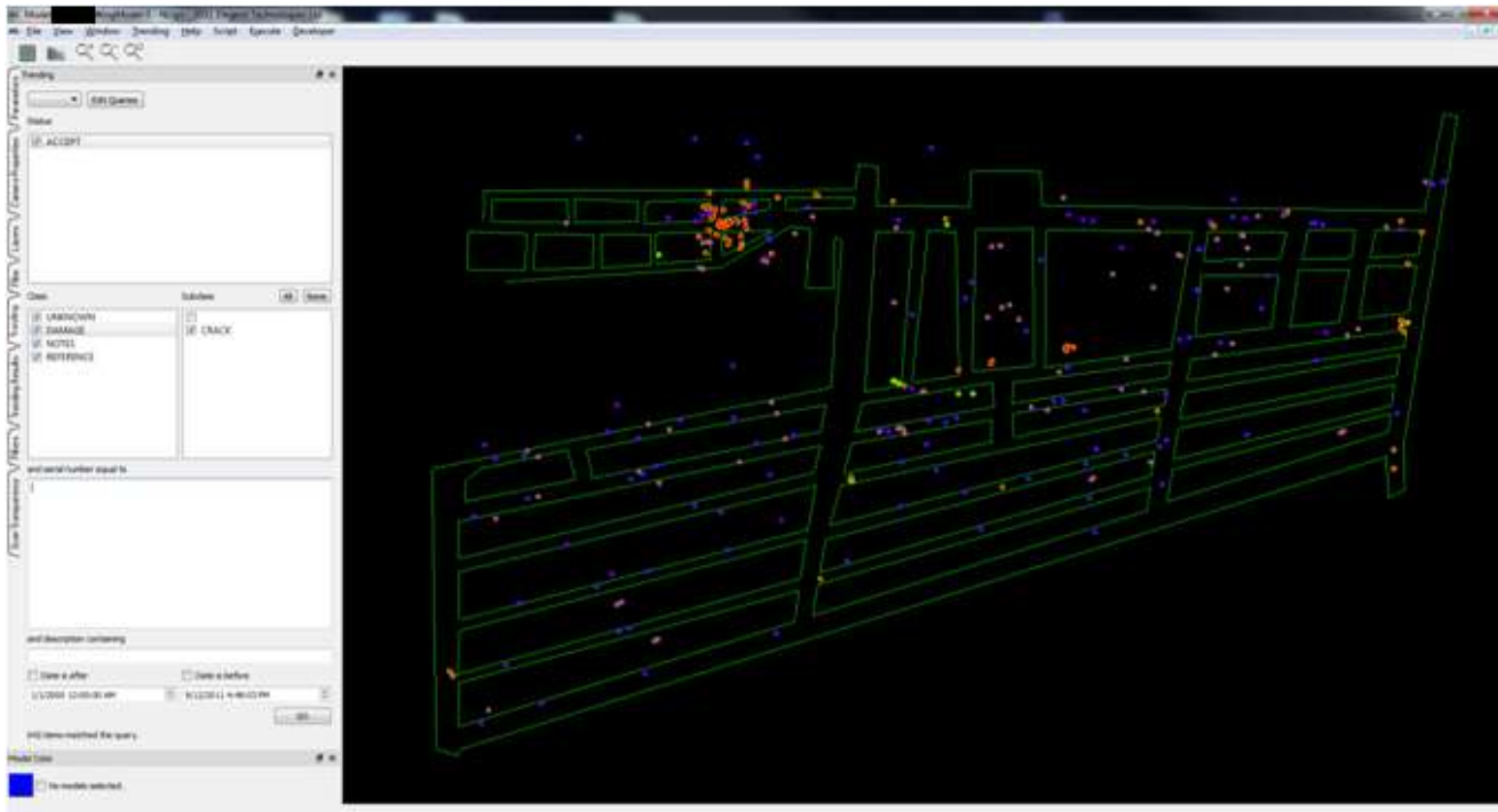


- Provide real time insight into area coverage
- Highlight areas of missing data
- Streamline production and maintenance practices

Gaps in Data



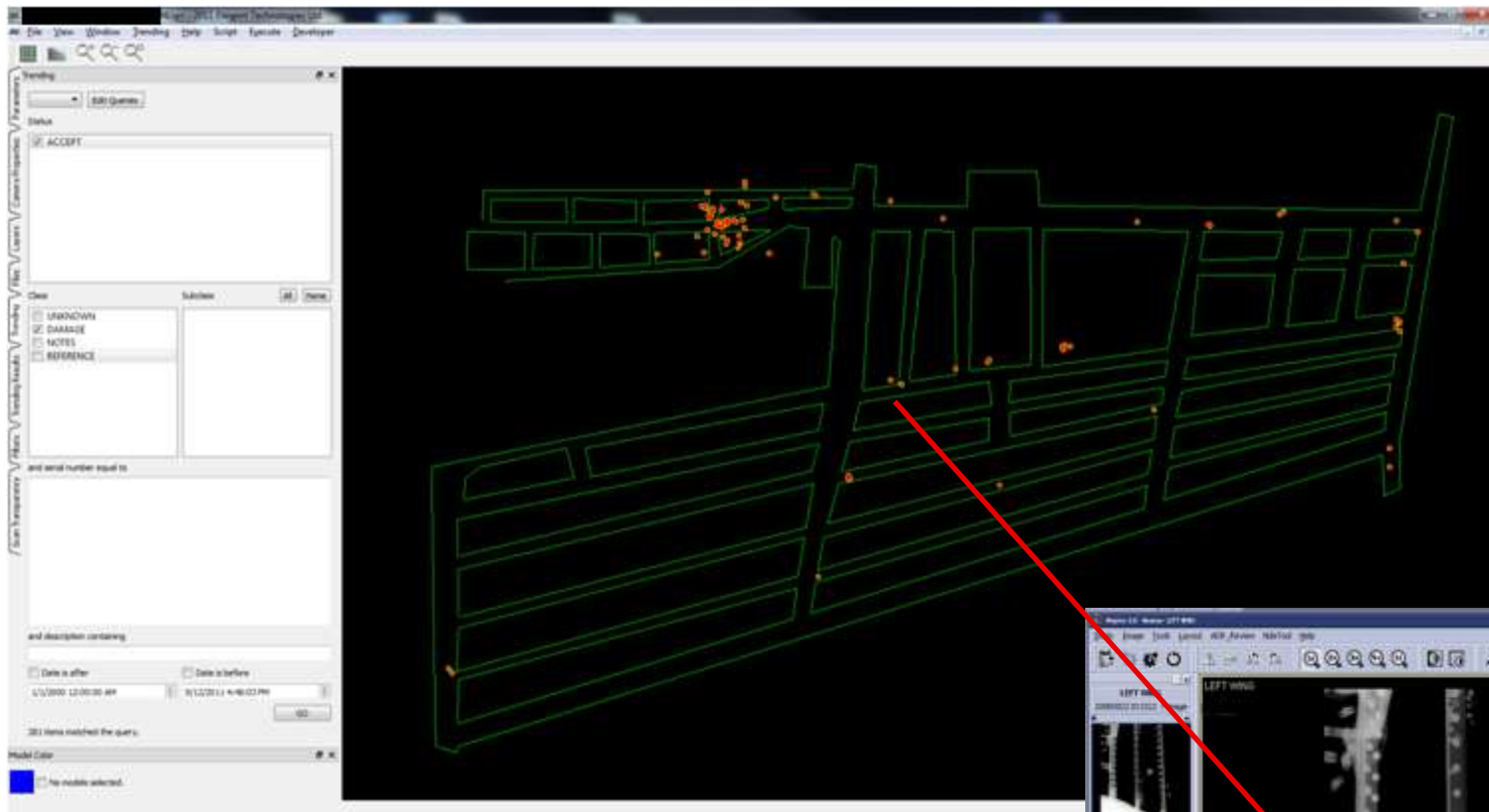
Analysis – Trending



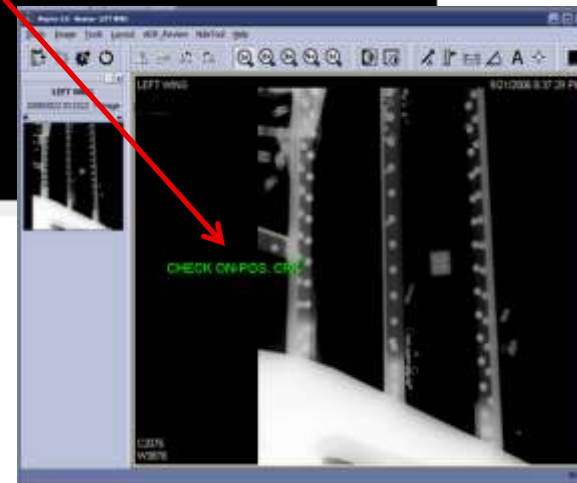
- 122 Tail numbers
 - Includes data from over 6,000 CR images
- All annotations on all images marked on diagram



Analysis – Additional Trending



- Drill down capability for specific items
- Access parent image

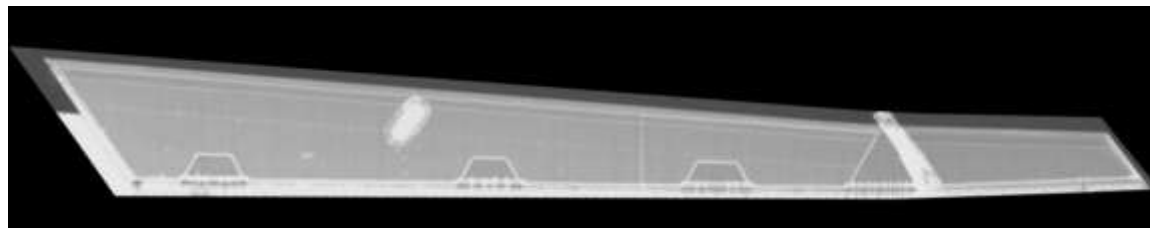




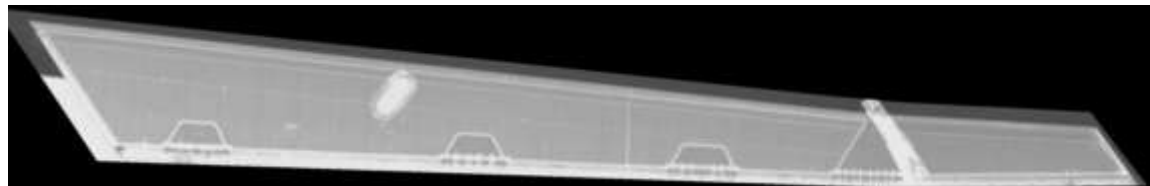
Analysis – Comparison



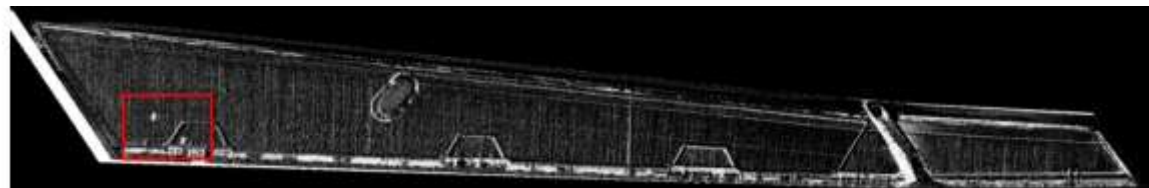
Original scan



Scan after
maintenance



Difference between
scans



- Help identify changes in the structure since the last inspection
- Highlight differences before and after significant events
- Increase accuracy of engineering manager's as-maintained knowledge



Reporting



Photo: AFMC Form 806
(NDI completion document)

- Generate reports
- Same analysis
 - Trending
- Store within appropriate database set
 - Form stored with data



Manufacturing Process Control Improvement



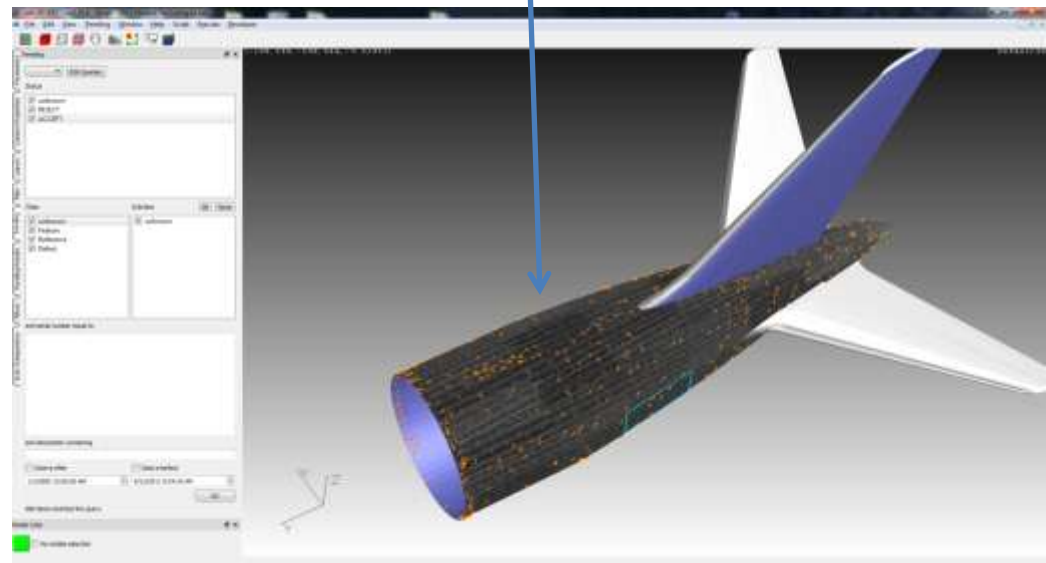
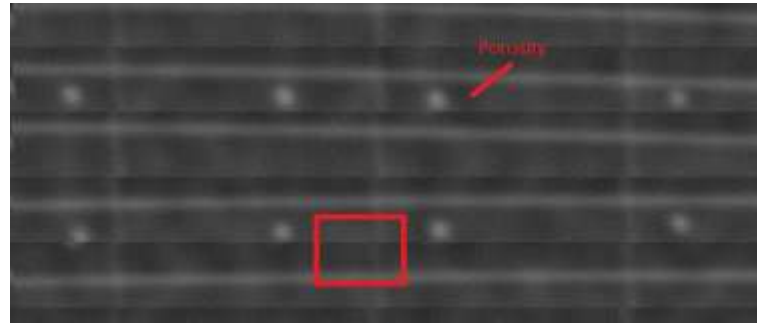
- Commercial aircraft production
 - Composite part manufacturers
- Goal of this effort is manufacturing process control improvement
- The data in the following slides is synthetic, but exemplifies the capabilities that are being provided for one customer



Manufacturing Process Control Improvement

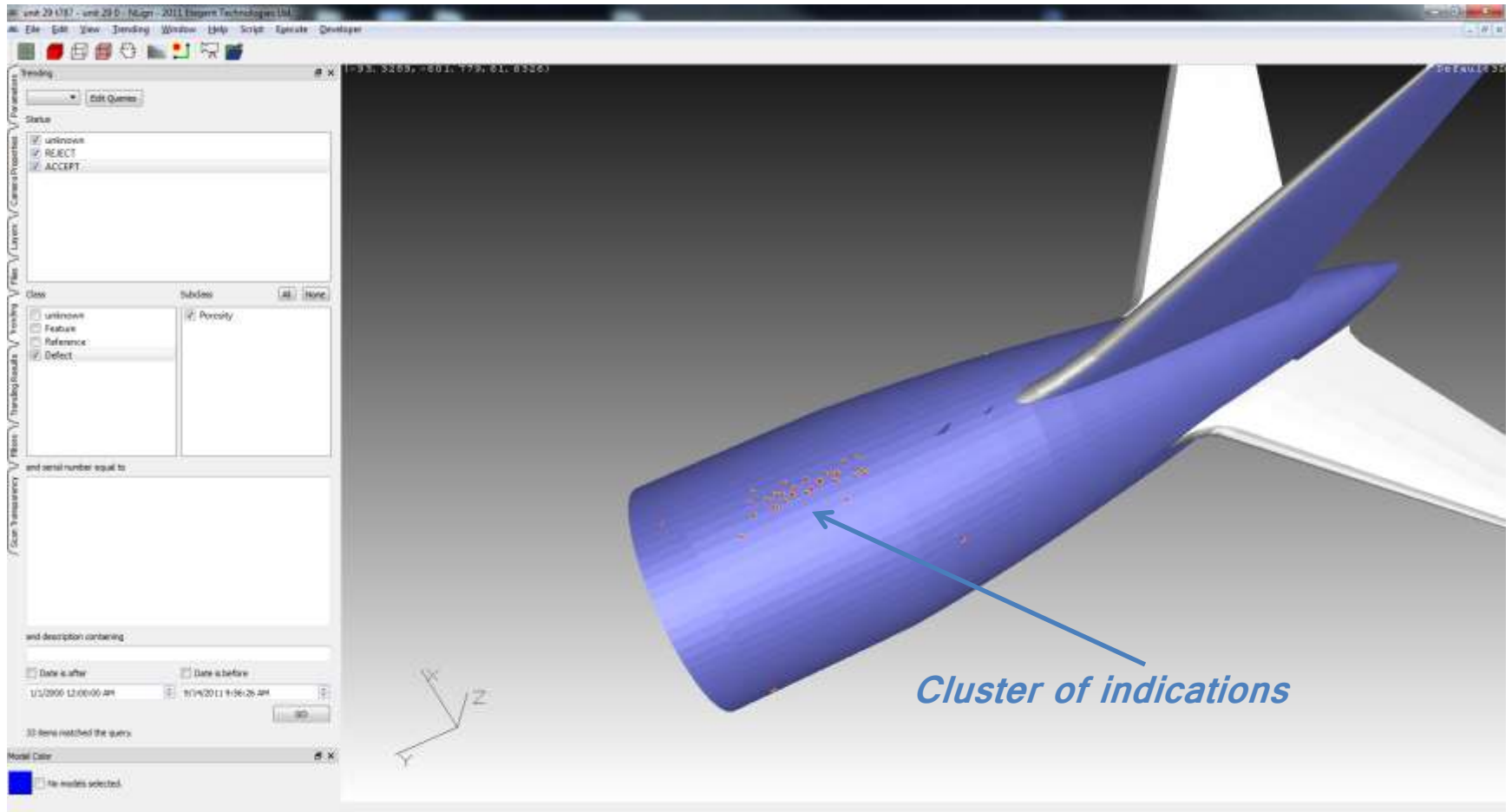


- 125 individual scans mapped to model
- Inspector annotations also mapped



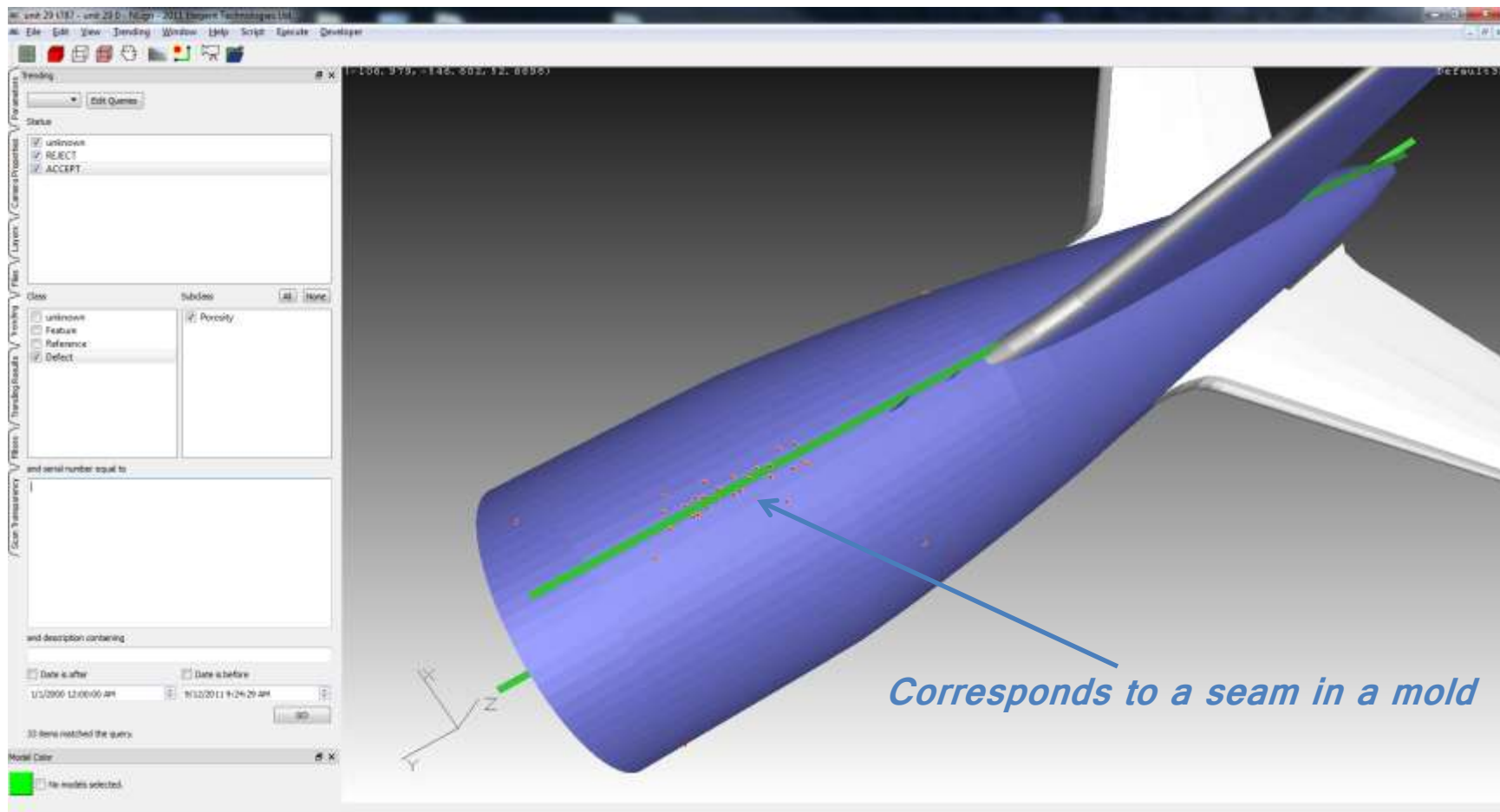


Manufacturing Process Control Improvement





Manufacturing Process Control Improvement



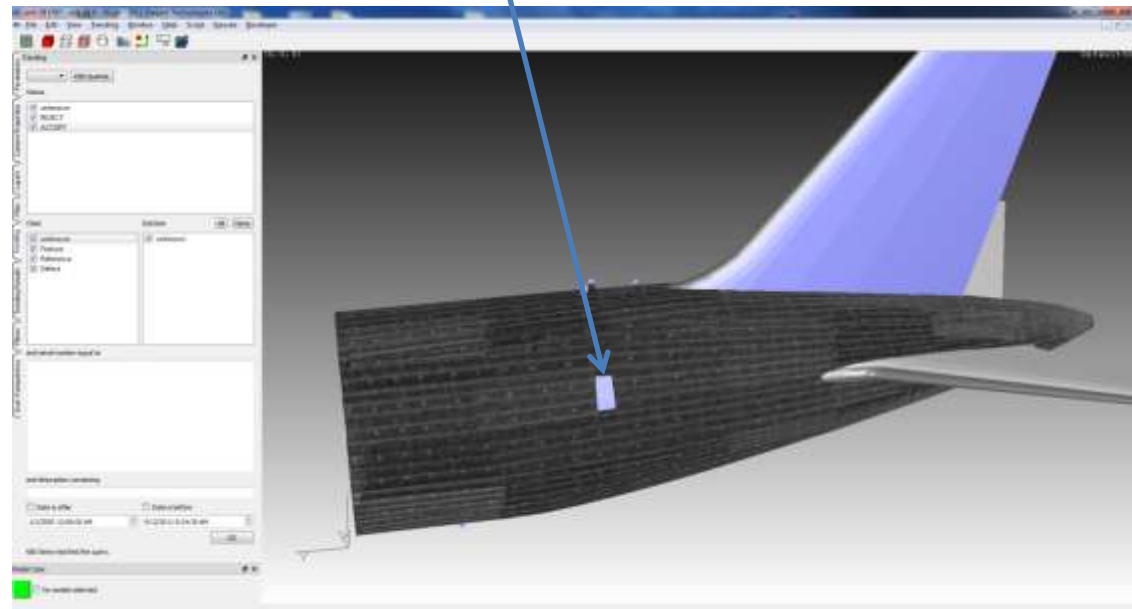


Manufacturing Process Control Improvement



- Verify 100% inspection coverage
- Obvious when mapped to a model of the structure

Missing coverage





NLign Future Directions



- Integrate functions for mapping point inspection data to CAD models
 - Surface and bolthole eddy current
 - Ultrasonic A-scan data
 - Others...
- Implement Nlign onto AF IT Network (NDAA/DIACAP)
 - Streamline communication between MX and engineering
 - Take advantage of file storage capabilities



NLign Future Directions



- Build link with configuration management software (e.g. Teamcenter - Siemens)
 - A-10 serve as pilot
 - Link NDI data to S/N configuration
 - Leverage archival capabilities
- Link with other software systems
 - AFGROW
 - Other CAD models (CATIA, Solidworks, etc.)



Conclusions



- As aircraft age, more data is needed to maintain safe aircraft
 - Capitalize on NDI data already being collected
- NLign software developed to address this need
 - Provides semi-automated organizing, archival, and analysis capabilities
 - Can be used in production and maintenance
 - Set up requires NDI data and a CAD-like model
- Future directions will make NLign more viable
 - Integration onto IT Network
 - Integration with other systems (NDI and engineering)



Acknowledgements



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