OCTOBER 6, 2021



Advancing Toward Quality 4.0 in Composites Manufacturing



Scott Blake, President

Agenda





- Current status of quality processes
- Goals for quality processes
- Spotlight on automatic inspection
 - Current status
 - Advancing automatic inspection to Quality 4.0 capabilities
- Bringing Quality 4.0 to your fabrication shop

Manual Quality Processes

ALIGNED VISION

- Composites automation has focused on fabrication processes
- Quality processes have not kept pace
 - Paper-based process control
 - Manual inspection
 - Paper-based reports

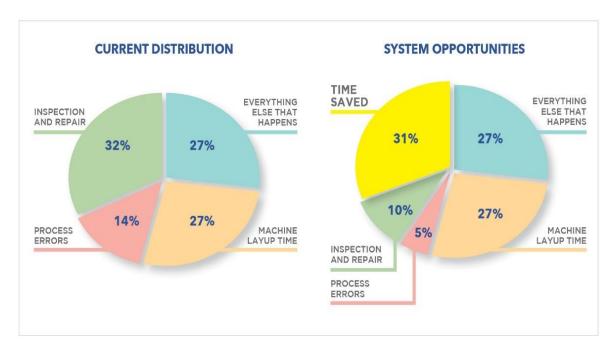




Manual Quality Processes



- Electroimpact
 AFP study
- Only 27% value-add time
- Potential savings from automated quality processes:
 31% of cycle time

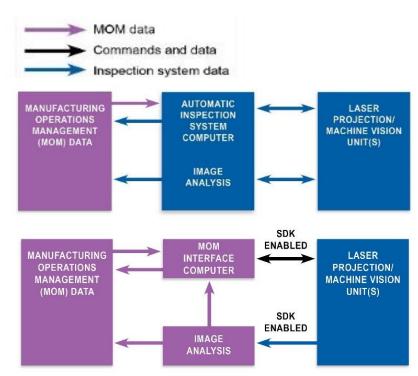




Quality 4.0 Goals



- Are you building what you designed? How do you know?
- The value of more quality data
 - Scrap reduction
 - Lightweighting (less overdesign, better performance)
 - Higher throughput
- Quality 4.0
 - Integrate with ERP, MES, QMS





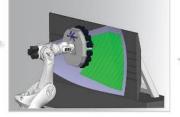
Quality 4.0 Digital Thread



- Method for automatically capturing thousands of tagged images
- AI/ML-based algorithm development
- AI/ML democratization through low-code software

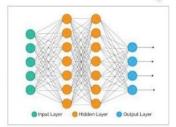














Spotlight: Automatic Inspection



CHALLENGES:

- Complex set of attributes to inspect
- Requires application-specific inspection engineering
 - Capture tagged images
 - Generate analysis algorithms
 - Weeks-long process with current technologies



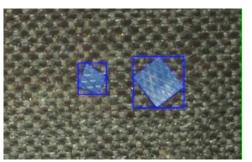
LASERVISION

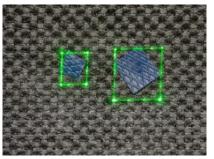
ALIGNED

MACHINE VISION SYSTEM

- NOT Metrology
- CAD model used to:
 - Aim camera
 - Project reference lines
 - Analyze data
- Machine vision captures small, high-res images in large, complex field





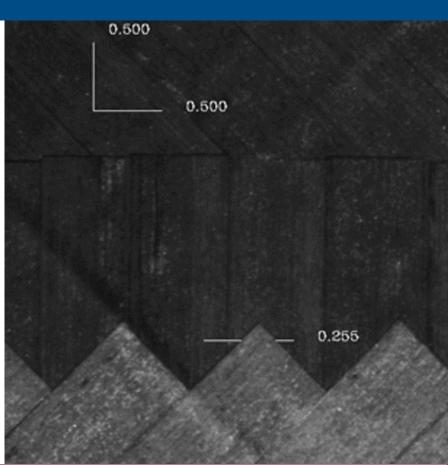


LASERVISION



MACHINE VISION SYSTEM

- Faster than point-cloud metrology
- Photogrammetric transform defines relationship between camera and feature
- Each pixel of 2D image dimensioned relative to 3D surface
- Gauging function assesses feature locations on a surface assumed to be correct
- Visible attributes recognized



LASERVISION STATUS



AUTO INSPECTION FOR AFP

- Boeing 777X
- Wingskin and Spar Cells
- Inspection occurs on any visible surface without stopping layup
- Suspect locations pinpointed with laser projection
- Inspection and projection functions integrated with cell controller with SDK



LASERVISION STATUS



AUTO INSPECTION FOR HAND LAYUP

- Sikorsky Blackhawk
- Main Rotor Spar Cells
- Laser projection for hand layup
- Automatic Inspection replaces:
 - trained inspector
 - with calibrated instruments
 - for flight-critical characteristics



LASERVISION STATUS



LAB DEVELOPMENT OF UNIQUE APPLICATIONS

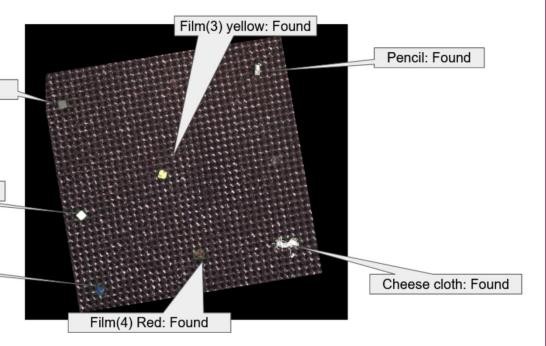
• 0.125" FOD

Viewed from 10'

Release paper: Found

Plastic glove: Found

Film(1) Blue: Found



Applying Al/ML



LOW-CODE AI/ML

- Data in: Tagged images identified as flaw-free or containing a particular flaw
- ML model trains a classifier to categorize images with similar characteristics



Applying Al/ML



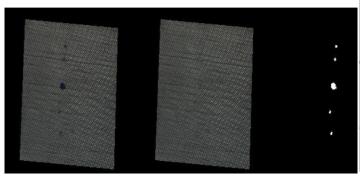
≪ sway ai ② Low-code Aligned-Vision FOD Detect Define Project -Setup Data Prepare and Annotate Data - Train and Evaluate Models Test Models Setup Business Logic ML interface Training data set developed Data set source Local files SELECT FILES... Drop files here to upload Drag and drop files here to upload. sway ai Accepted formats: JPG, PNG. Minimum size (px): 64 x 64. Maximum size(px): 4096 x 4096. Images must have the same dimensions. Create new project Search pre-built workflows **Auto Inspection Facial Recognition** All workflows Need help or build your own workflow? Develops and deploy models for Develops models for facial BROWSE BY PROBLEM CATEGORY foreign object detection auto in... recognition at ATMs. Anomaly Detection **BACK** FINISH LATER Classification Clustering Recommendations Ranking Regression Learn more about these categories? CANCEL

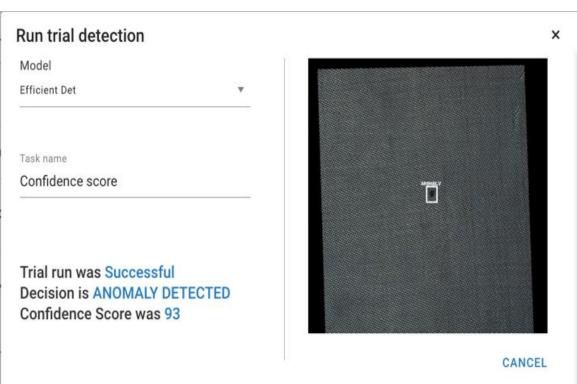
Applying Al/ML



 Development and training of ML tool with low-code system







Quality 4.0 Pilot Programs



- All data interfaced through Industry 4.0 systems
 - ERP
 - MES
 - QMS
- Software
 Development Kit



Quality 4.0 Pilot Programs



HAND LAYUP OPERATION

- Drop-in replacement for standard laser projector
- Image capture in background
- Build image database
- ML classifier training
- Qualify alongside traditional inspection



Quality 4.0 Pilot Programs



AUTOMATED PROCESSES

- Run standalone unit for initial application development
- Run automatic inspection in parallel with manual protocols
 - Continue ML training
- SDK integration
- Low-code ML for new applications



Next Steps



NOISIVE

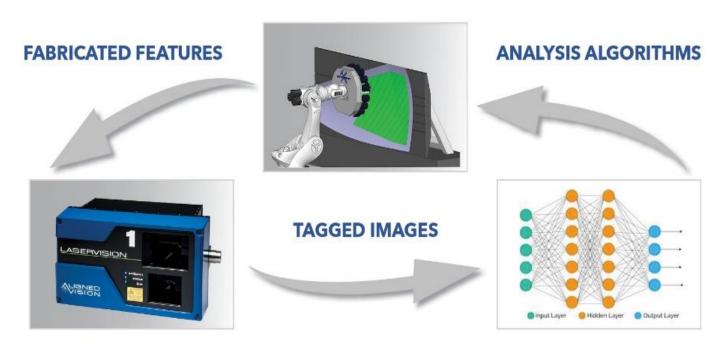
- Web demo
- Onsite demo
- Lease
- Purchase



Thank You!







Questions? Contact Scott Blake at sb@aligned-vision.com