CTMA TECHNOLOGY COMPETITION

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Problem: In Situ Surface Defects Need Rapid, Accurate Quantification

• Millions of dollars are currently lost because inspectors cannot adequately quantify surface defects, both on the shop floor and in the field
  – No quantitative, in situ measurement capability exists for analyzing corrosion, pitting, scratches, dents, nicks, etc.
  – Without quantification, operators err on the side of ‘reject’ or ‘rework’, often failing parts that would meet specification. Alternatively, an inspector may pass functionally defective parts. There is too much operator variability
  – A single, medium-sized GE turbine repair facility evaluated rejects in their metrology lab. They found that they were rejecting or reworking $4M of good material annually
• Current inspection methods are mostly qualitative: visual or scribe checking
• Secondary methods include examining replicated defects on a comparator or in a metrology lab with unacceptable delays for results and feedback
• An easy, handheld system for 3D feature quantification in the shop or field would dramatically improve inspection throughput, quality, and reduce repair costs
Solution: InSpec – Handheld 3D Shop Floor Gauge

- 4D Technology worked with GE, Pratt & Whitney, Cummins, Honeywell, General Motors, and others to define the product
  - Handheld, flashlight-sized, ruggedized, <0.0001” resolution, 1/3” x 1/3” field of view, 0.1” max height range, 3D mapping, automatic defect analysis
  - 4D’s InSpec is the world’s only handheld high-resolution 3D gauge
  - Unique capability due to patented combination of polarized light with fringe projection
  - Brings metrology to the part to measure very large components
  - Measure areas without line-of-sight, corners, bores, etc.

- Inspectors are taking measurements within 3 minutes and using system independently after < 1 hour of training
Video of Operation
Benefits

• Previously mentioned GE Engine repair facility believes they can eliminate 90% of false rejects using 4D’s handheld gauge ($3.6M savings/year)

• Inspector at another company said he went from 3 days replicating/measuring defects on a cowling to <4 hours with 4D’s instant in situ results
  – < 1 second between pressing trigger and reviewing results

• Quantification of defects is allowing manufacturers to collect trustworthy data for lifing models, providing confidence in acceptance/rejection criteria

• Digital record of inspection can be rapidly stored and shared across groups and facilities

• Elimination of replication material saves money and waste generated by the rubber material
Challenges & Risks

• Proven technology presents no risks for basic 3D measurement capability in shop floor or manufacturing environments

• 4D Technology is a small business and has not yet achieved DoD community awareness as we have in the civilian manufacturing space

• Need field trials (on ships, flightlines, etc.) to identify if a wireless InSpec system is necessary or merely nice to have

• Military needs may differ from commercial operations and may entail design modifications

• Major program risk is that current lack of broad-based feedback limits desirability and utility in many possible applications. 4D desires partners!
Innovation Status

- System currently at TRL 7-8 (System launched and beginning adoption)
  - > 12 units deployed at numerous aerospace and precision manufacturing firms
  - Wired version suitable for incoming QC/new-make production and service shops

- Main applications include:
  - Corrosion/wear quantification - area covered, volume of removed material
  - Scratch/nick/dent evaluation (cosmetic or function) – depth, length, area, volume, etc.
  - Edge break and precision radius measurement for new and repaired edges

- Main obstacle to expanded (field) use is ensuring maximum portability, likely via wireless/battery powered unit
  - Have 8 hour power supply/laptop, but operators would prefer Bluetooth/internal battery

- No competing product provides handheld, 3D surface imaging at high resolution
Vision / Final Thoughts

• DoD Integration
  – System is in production, CE certified, but not qualified against unique military requirements
  – System will need to be correlated against existing DoD inspection methods/requirements
    • Completed with various commercial customers but each customer has unique correlation needs
    • 4D can assist with gauge studies, ruggedness, and other performance evaluations
  – Data output is via standard formats (XYZ point cloud, .csv files) and integrates readily into factory control or 3D modeling regimes

• IP for system build held by 4D but users have rights to use as necessary

• 4D believes the InSpec Surface Gauge can revolutionize inspection via instant, quantified 3D measurements in any environment
Questions?