Increased inspection productivity through advances in Remote Visual Inspection (RVI)

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Abstract:

Remote Visual Inspection (RVI) allows the inspection of objects or components in complex systems such as engines without disassembling the engine modules, surrounding structure or removing the engine from an aircraft. This paper will present a concept for integrated data collection, management and sharing as a way to increase engine inspection efficiency and contribute necessary input to a condition-based maintenance approach.

Increased inspection productivity can be attained by an integrated software solution that provides a customizable guide for different engines. Solutions allow centralized planning of different engine inspections, including details of annotation and other inspection requirements along with automatic report generation. This information can be archived via a standard software protocol for long term data utility and multi-system communication.
Keywords: RVI, engine inspection, productivity, digital data management

1. Introduction

Remote Visual Inspection (RVI) has changed dramatically with the evolution from rigid borescopes and fiberscopes to flexible video borescopes (or videoprobe). Digital and optical technologies continue to advance, creating an opportunity for additional features. Sophisticated and critical applications such as aerospace engine inspections are a subset of uses where additional capabilities offer improvements in inspection or inspection processes.

The most capable video borescope platforms combine superior optical and light output with data processing capability that brings a new dimension to remote visual inspection. This paper will review technology advances and data management capabilities available.

2. Equipment advances

In aviation, both flexible fiberscopes and rigid borescopes have largely been replaced with flexible video borescopes or videoprobes. These products offer better resolution than simple fiberscopes and more flexibility and operational efficiency than rigid borescopes. The convenient viewing and assessment of images on a monitor screen that is far less fatiguing than conducting inspections using the eyepiece of a rigid borescope or fiberscope is also an advantage, along with the capability to save and store still and moving video images in digital formats. Additionally, the ability to simply but accurately measure defects is of great importance in aero-engine inspections.

An example of this increased capability is the GE Inspection Technologies XLG3, a versatile platform designed to provide a portable and powerful asset to RVI technicians. Key features available in advanced systems like this include:

1. Light Output: All-Way probe articulation and high density 75-watt lamps generate light output that is two (2) times greater than other video scopes, proving light output of up to 200 lumens for sharp, clear images. Sophisticated image controls include an adjustable brightness feature, and automatic or manual exposure allows full control in any inspection environment.
2. Image Quality: Improved lenses, digital-signal processing, and an extra bright, high resolution, wide VGA LCD screens now available deliver higher quality images than previously available. Bright, distinct inspection images allow fast defect identification and decision-making.
3. User Interface: Intuitive control buttons and drop-down menus quickly guide operators through system functions. Operators can choose between a multi-function joystick for one-handed operation, or a lightweight remote control for hands-free control of handset functions.
4. Versatility: State of the art videoprobe systems features numerous different interchangeable, QuickChange probes, allowing the probe diameter and length to be quickly reconfigured for maximum productivity. Adjustable probes come in a wide selection of optical tips, probe lengths (from 2 to 9.6 m), measurement capabilities, and in 3.9, 5.0, 6.1, and 8.4 mm diameters. More capable systems also accommodate multi-national companies and organizations with more than 11 language options for operation and documentation
5. Durable & Powerful: The QuickChange probes are built for increased durability with Titanium camera head that is 8 times stronger than older designs. The bending necks seams are laser-welded to strengthen critical joints. 6.1 mm and 8.4 mm probes are built with a double tungsten braid insertion tube for added crush resistance. All of which add to longer probe life. Advanced videoprobes provide a built-in Intel Pentium-M CPU.

2. Data Management Solutions

2.1 Menu Directed Inspection

Although technically advanced equipment is desirable for aerospace engine inspections, the productivity of an inspection process is often related to the people who must perform the inspection. A new software capability is now available to aid in the inspection and documentation of engines and other frequent inspected devices.

MDI is a solution that provides a guided inspection, where context is automatically added to images that are captured during a visual inspection. A supervisor or manager can create a directed inspection (detailed list of the items to be inspected in the proper order) using a PC or directly on the videoprobe. When an inspector uses the device to perform an inspection, it will deliver annotations and file names to the captured images. The operator can accept the merged image and information as it appears or further annotate it measurement or other notes. After the inspection, users can generate a report directly from the XLG3 Menu Directed Inspection (MDI) software.

The addition of MDI to an already powerful videoprobe like the XLG3 allows asset owners to standardize the inspection processes across a fleet or engine type. A sample of the software screen outlining the inspection process and an inspection list on the videoprobe are shown in figure 1 and 2 respectively.

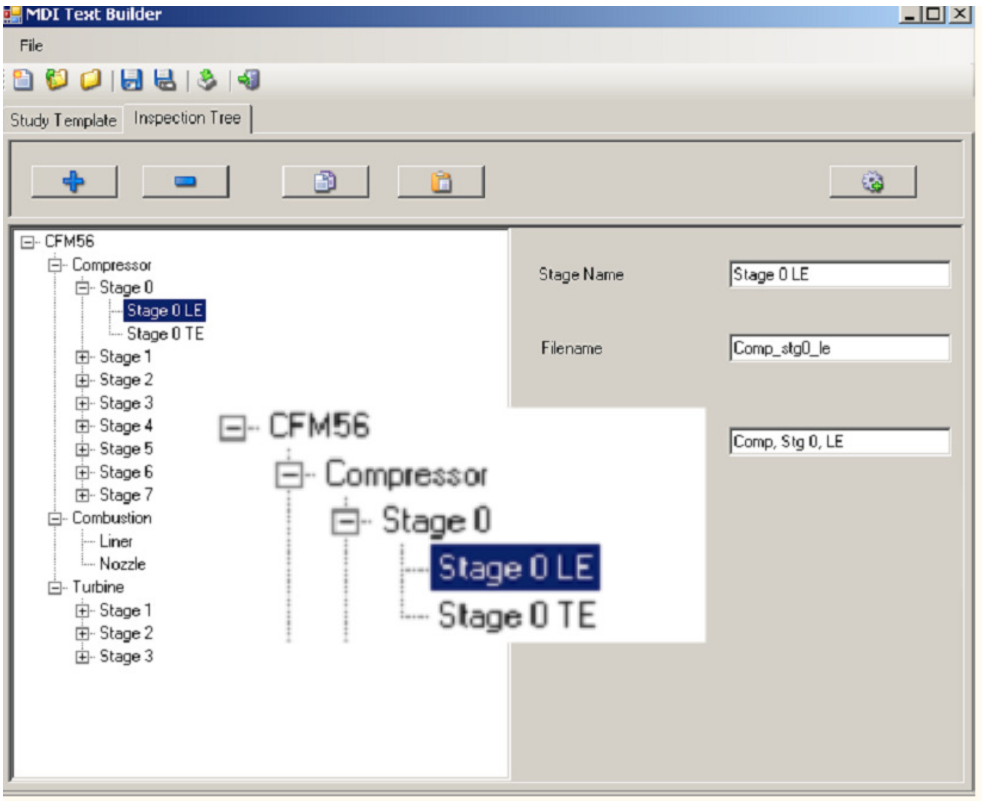

Figure 1; Sample screen of inspection list, defining annotation and data tags. Information can be entered with a simple program on a PC or on an XLG3™ VideoProbe® systems,

Figure 2; Sample inspection list selection screen as seen by operator on the VideoProbe®

Once the user has performed the guided inspection and collected the required images with tagged data, the MDI can auto-generate a report – saving time, improving quality and increasing productivity. A sample of the automatically generated report is shown in figure 3.

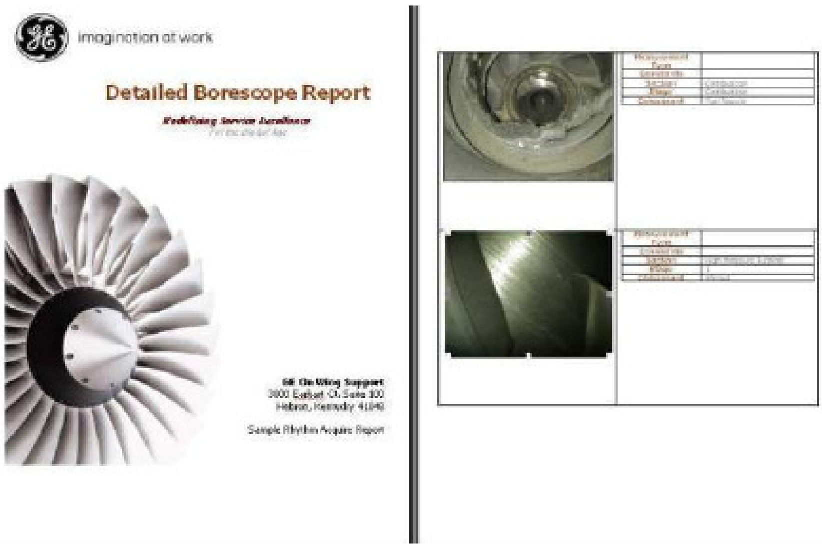

Figure 3; Automatically generated report. File names and descriptions of all images are known

2.2 Rhythm Inspection Management

The Rhythm suite of user-friendly software from GE Inspection Technologies offers advanced image review tools and data management for all Remote Visual Inspection (RVI) & X-ray (including computed radiography, digital radiography and film digitization) testing methods. Its advanced data sharing capabilities allow significant improvements in productivity and enable faster identification of quality problems, leading to reduced production defects and/or better in-service asset management. A DICONDE software platform, Rhythm provides the ability to maintain data transfer formats in an industry non-proprietary standard. Rhythm provides an elegant and cohesive solution to data management and sharing needs, while creating a stable platform for future NDT software capabilities.

DICONDE is an extension of the DICOM international standard and benefits from its years of development. The ASTM standard (ASTM E-2339 “Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation”) was established in 2004. What does these mean to NDE users? In it’s simplest form, it means if your NDE software is truly DICONDE compliant, you will benefit by:

- Protecting your software investment by avoiding proprietary data formats
- Easily sharing your inspection data with internal inspectors and even customers
- Search capability that allows you quickly and simply find your historical inspection data
- Flexibility to choose “best of breed” NDE components from multiple vendors with no integration issues
- Archive multiple modalities from multiple inspection equipments vendors in one solution

3. Summary

This paper presented a concept for integrated data collection, management and sharing as a way to increase engine inspection efficiency and contribute necessary input to a condition-based maintenance approach.

Increased inspection productivity can be attained by an integrated software solution that provides a customizable guide for different engines. Solutions allow centralized planning different engine inspections, including details of annotation and other inspection requirements along with automatic report generation. This information can be archived via a standard software protocol for long term data utility and multi-system communication.