LARGE AREA, REAL TIME INSPECTION OF ROCKET MOTORS USING A NOVEL HANDHELD ULTRASOUND CAMERA

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Large Area, Real Time Inspection of Rocket Motors Using a Novel Handheld

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The original document contains color images.

Describe operation of Imperium ultrasound camera
Describe work done with camera under Air Force Research Laboratory SBIR program
Present results to date and work remaining under this contract
Purpose of Work

• Describe operation of Imperium ultrasound camera
• Describe work done with camera under Air Force Research Laboratory SBIR program
• Present results to date and work remaining under this contract
Objectives

**Phase I**
- Demonstrate the applicability of the Imperium ultrasound camera to the inspection of Solid Rocket Motors (SRM)

**Phase II**
- Develop a prototype camera that can be used in either handheld or production settings
- Test prototype camera to determine:
  - Level of performance
  - Ability to detect typical flaws
  - Determine potential time savings

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System Configuration

TEST ITEM

TRANSDUCER

CAMERA HEAD

CONTROL UNIT

COMPUTER

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Detector Array

- Key feature to creating ultrasound camera
- Converts ultrasound to electrical signal
Operation – Pulse Echo

- Often done in water tank:

- Dark areas have high attenuation

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Operation – Pitch-Catch (cont.)

- Often done in water tank, but portable cameras are feasible

- White areas where there is the highest reflection

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Operation – Pulse-Echo

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Operation – Pulse-Echo (cont.)

- Beamsplitter allows for collinear transducer beam
- 50% of pressure is lost in reflections

- White areas are regions of high reflectivity
- Range gating is feasible
Phase I Effort

- Demonstrated feasibility when tested in Pitch-Catch mode
Phase I Effort (cont.)

- Demonstrated ability to detect flaws in many sample parts

- 1 MHz transducer effective for many solid composites
- Up to 5 MHz used for some honeycomb core
- Exterior cork heat shield not successfully penetrated
- Phase II initiated

Undamaged

Delamination

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Phase II System Configuration

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Camera Head

- **Auxiliary Handle**
- **Fill Ports (2)**
- **Focusing Knob**
- **3.5” LCD**
- **Trigger for Image Capture**
- **LCD Controls**

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Portable System Performance

- Demonstrated functional capability:
Production Camera

• Designed to interface with existing SRM scanner

• ATK to compare scan times to existing production systems
• Working to create large composite image from multiple small images

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Summary and Conclusions

• Concept demonstrated: capability of seeing flaws on representative composite parts
• Limited testing with portable system has detected similar flaws
• It is expected that production system will demonstrate a significant reduction in test time over present systems
• Concept is transferable to areas other than nondestructive evaluation of solid rocket motors
Future Work

**Program Tasks**

- Complete quantitative testing of system using calibrated standards
- Deliver system to ATK for in-plant use in both handheld and production configurations
- Submit test report on findings
- Deliver hardware to AFRL IR&D

- Improve image quality
- High-speed digital downloads
- Increased FOV
- Decreased size and weight
- Improved range-gating