AD-A141 164 ELECRROMAGNETIC INSPECTION OF WIRE ROPES USING SENSOR ARRAYS(U) NDT TECHNOLOGIES INC SOUTH WINDSOR CT H R WEISCHEDEL 10 OCT 83 N00014-83-C-0484 1/1

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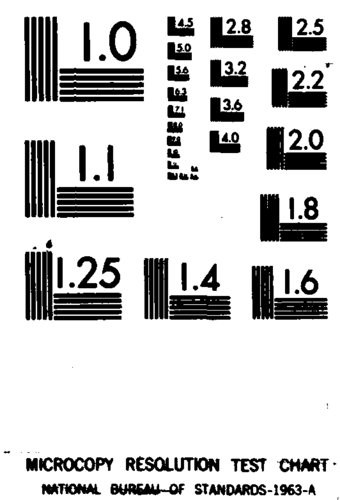
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AD-A141 164

Contract N00014-83-C-0484

ELECTROMAGNETIC INSPECTION OF WIRE ROPES USING SENSOR ARRAYS

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10 October 1983

Quarterly Progress Report for Period
15 June 1983 - 15 September 1983

Prepared for

OFFICE OF NAVAL RESEARCH
DEPARTMENT OF THE NAVY
800 N. Quincy Street
Arlington, Virginia 22217

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SUMMARY

During the time period from 16 June thru 16 September 1983, feasibility of the proposed main flux method as described on pp. 35-41 of the Phase II Proposal was established. Several different prototype implementations of the method are now available. First comparative tests demonstrated the superior performance of the prototypes as compared to two competing instruments.

An IBM Personal Computer including analog interface circuitry was purchased. A predictive coding algorithm was implemented.

PROGRESS

Specifically, with respect to the Tasks formulated in the Phase II Proposal, the following was accomplished:

1. Leakage Flux Method for the Quantitative Characterization of Localized Defects

Task 1.1 : Improve Existing Signal Conditioning Circuitry

No action

Task 1.2 : Design, Build and Evaluate Improved Sensors

The sense coils develcped for the Loss-of-Metallic-Area instrument (Task 2.2) are in all respects superior to any previously used sensors. They are very well suited for the detection and quantitative evaluation of localized defects. No separate sensors will be required for the detection of localized flaws.

Task 1.3 : Implement Extended Automatic Defect Identification Method

No action.

2. Main Flux Method for the Quantitative Characterization of Extended Defects

Task 2.1 : Design and Build Magnetizer Assembly

The Magnetizer Assembly was designed, built and tested. While first lab tests showed a completely satisfactory prformance, later field testing revealed some peculiarities of the present design which are, at the present time, not well understood and which should be investigated and remedied. It appears that problems are caused by the fact that, during testing, the instrument permanently magnetizes (or remagnetizes) the rope. This changes the flux pattern in the rope inside the test instrument which, in turn, causes an offset of the zero setting of the test signal. Note that the Canadian Magnograph instrument shows the same behavior. The problem can be bypassed by making a first test run to let the instrument magnetize the rope in a uniform fashion, followed by a second run, including an appropriate reset of the integrator voltage, to obtain the actual test results. However, this procedure is comparatively complicated and not immediately obvious. It might cause problems for the less experienced operator. The above phenomenon will be further investigated and, if at all possible, corrected.

Task 2.2 : Design and Build Main Flux Sense Coils

Sense coils in accordance with Figure 17 of the Phase II Proposal were designed, manufactured and evaluated. Ferromagnetic inserts, for adapting the coils to different rope sizes, were also designed and manufactured. These sense coils, including the inserts, can be used for the detection of localized flaws as well as distributed flaws. They are in all respects (i. e., resolution and signal/noise ratio) superior to the previously used differential coils. In addition, test signals are less complex and easier to interpret.

Task 2.2 : Design and Build Signal Conditioning Circuitry

Circuitry for the long-term drift-free integration of the coil signals was developed. In addition, circuitry was developed for balancing the integrator and to compensate for small offset voltages mostly caused by thermal gradients within the test setup. The use of chopper stabilized operational amplifiers allows integration with negligible drift over time periods of 10 to 20 minutes. Or, by introducing a minute proportional feedback, the integrator can be operated indefinitely without resetting at the expense of an insignificant loss of accuracy.

3. Combining Leakage Flux and Main Flux Methods

Task 3.1 : Design, Build and Evaluate Combined Instrument

The new main flux instrument can detect distributed and localized flaws equally well. No separate sensor is required for the detection of localized defects.

4. Digital Processing of Test Signals

Task 4.1 : Selection of Digital Signal Conditioning Instrumentation

An IBM Personal Computer including analog interface equipment was purchased. This data acquisition/processing system is now operational. Except for some minor software problems, which are presently being corrected by the manufacturer, this system appears adequate for the intended purposes.

Task 4.2 : Development of Interfacing Circuitry

A data acquisition cassette recorder was selected, and has been ordered.

Task 4.3 : Develop Algorithms for Digital Signal Processing

A linear predictive coding algorithm was implemented. While this algorithm can improve the signal/noise ratio of a simulated signal, the test rope which is presently being used for lab testing is not sufficiently noisy to demonstrate the effectiveness of this algorithm. Further evaluation has to be postponed until a cassette recorder is available and actual field test data can be processed digitally.

5. Instrument for the Inspection of Wire Rope End Sections

Task 5.1 : Develop, Manufacture and Evaluate Instrument for the Inspection of Wire Rope End Sections

No action.

6. Testing

Task 6.1 : Perform Lab and Field Tests

Lab and field tests were performed. Recent comparative tests at the facilities of the British National Coal Board in Bretby, England demonstrated the superior resolution of the new main flux instrument as compared to the Canadian Magnograph and the British Plessey instrument. The new method allows a direct quantitative determination of loss of metallic cross-sectional area for flaws longer than 2 inches (as compared to 30 inches for the Magnograph). Shorter localized flaws are indicated qualitatively.

Further field tests were conducted with the cooperation of the Mine Safety and Health Administration at the Schwartzwalder uranium mine in Golden, Colorado. The above mentioned problems associated with the remagnetization of the rope under test were first discovered during these field tests.

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