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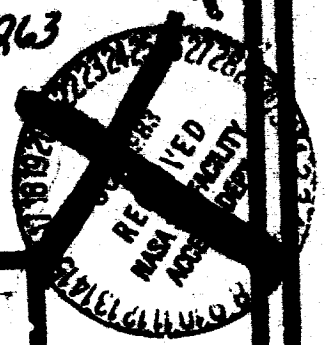

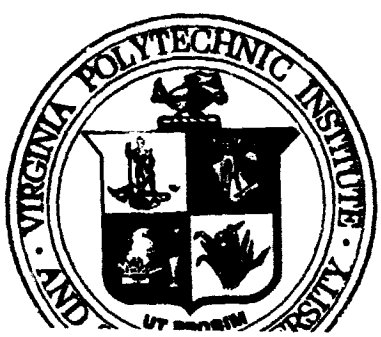

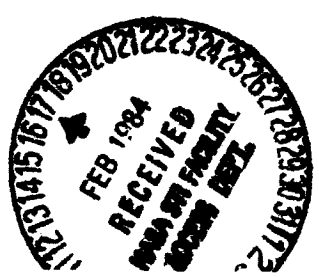

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FINAL REPORT

"Analysis and Acoustooptical Measurements of
Bulk and Surface Acoustic Wave Fields"

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SUMMARY

This summary is submitted as the final report for NASA Research Grant NAG-1-263 titled "Analysis and Acoustooptical Measurements of Bulk and Surface Acoustic Wave Fields". The major part of this report is a collection of technical articles based upon work supported of technical articles based upon work supported by this grant. Since this research is a continuing effort in several areas, papers which have been published or submitted during the grant period, or which are currently being prepared for submission, are included. These papers are divided into sections by topic and included as Appendices.

The primary objective of this grant research, from October 1, 1982, to September 30, 1983, was to develop multielement ultrasonic transducers having full field amplitude and phase control. Such transducers and their supporting electronic instrumentation have been designed, constructed, and evaluated, and the results have been reported in several papers [1-14, Appendix A]. Additional analytical and experimental research related to this problem is being partially supported by continuing NASA grant funding [15].

Related secondary objectives during this grant period have included the three-dimensional mapping of acoustic fields using optical scanning techniques [16-21, Appendix B], the measurement of the surface particle displacement caused by an idealized impulse load on the surface [22, Appendix C], and the measurement of two-dimensional stress distributions using embedded optical fiber sensors [23-27, Appendix D]. Several related results outside of these specific areas are included in Appendix E [28-30].

DISCUSSION

In this section, the major accomplishments in each research area during the past year are briefly reviewed and suggested additional work is described.

A. MULTIELEMENT ULTRASONIC TRANSDUCERS

Both continuous and pulsed fields generated by multielectrode piezoelectric transducers have been studied analytically. A simple numerical analysis technique has been developed for the evaluation of arbitrary field propagation in either homogeneous or inhomogeneous media. Experimental measurements of field evolution for the prototype transducers designed and constructed as part of the grant research have been compared with the theoretical values predicted by this scheme with good results.

Transducer designs employing both quartz and PZT active elements have been designed, constructed, and tested. New designs which utilize electrode area variations to control both input impedance and interelectrode voltage division problems have been implemented.

B. THREE-DIMENSIONAL ACOUSTIC FIELD MEASUREMENTS

A scanning interferometer technique has yielded three-dimensional measurements of acoustic fields in water. The method has been used to measure the field profile at different distances from a uniform-profile ultrasonic transducer with results that agree well with theory and with conventional acoustic transducer scans.

C. MATERIAL SURFACE IMPULSE RESPONSE

An optical fiber path differential interferometer has been used to measure the mechanical impulse response of a solid surface. These measurements have importance in nondestructive evaluation and acoustic emission.

D. OPTICAL FIBER SENSOR DEVELOPMENT

Two results should be noted here. First, a 50-fiber array embedded within thin plastic layers has been used to measure stress distributions due to uniform and point loading. Second, a simple robotic gripper has been used to demonstrate the potential of using optical fiber sensors to determine object location and applied pressure in materials handling mechanical systems.

E. OTHER RELATED PUBLICATIONS

Two papers have also been published which relate to ultrasonic interface waves, and one submitted paper reports the theoretical operation of single mode acoustic waveguide.

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APPENDIX A

MULTIELEMENT ULTRASONIC TRANSDUCERS