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# Ultrasonic Transducers For Nondestructive Testing

**Maurice G. Silk**



## **Ultrasonic Transducers For Nondestructive Testing:**

**Ultrasonic Transducers for Nondestructive Testing**, Maurice G. Silk, 1984-01-01      **Capacitive Micromachined Ultrasonic Transducers for Non-destructive Testing Applications** Lawrence Lai Pong Wong, University of Waterloo. Department of Systems Design Engineering, 2014

Ultrasound is a popular technique for industrial non destructive testing NDT applications By sending ultrasonic waves into an object and observing the amplitude and the delay of the reflected or transmitted waves one can characterize the material measure the thickness of the object and detect discontinuities flaws as well as the size location and orientation of the defects in the object Traditionally ultrasonic transducers for NDT are made with piezoelectric crystals Meanwhile another class of ultrasonic transducers known as capacitive micromachined ultrasonic transducers CMUTs have become popular in medical ultrasound research because of their large bandwidths and other attributes that allow them to be integrated into the tip of a catheter However CMUTs have not been widely adopted in ultrasonic NDT applications In this thesis three important CMUTs characteristics that could potentially make them attractive for NDT applications are introduced and demonstrated First CMUTs can be beneficial to NDT because the fabrication techniques of CMUTs can easily be used to implement high frequency high density phased arrays which are essential for high resolution scanning Surface scanning using a 2 D row column addressed CMUT array was demonstrated Secondly CMUTs can be integrated with supporting microelectronic circuits thus one can implement a highly integrated transducer system which can be useful in structural health monitoring NDT applications Front end microelectronic circuits that include a transmit pulser and a receive amplifier were designed tested and characterized Thirdly CMUTs are suitable for air coupled applications because of their low acoustic impedance at resonance Air coupled CMUTs fabricated in a standard RF MEMS process were characterized and tested This thesis concludes with an analysis of the potential usefulness of CMUTs for ultrasonic NDT While many ultrasonic NDT applications are better off being performed using conventional piezoelectric transducers CMUTs can and should be used in certain NDT applications that can take advantage of the beneficial characteristics of this exciting transducer technology

**Transducers for Ultrasonic Flaw Detection** V. N. Bindal, 1999

As a large variety of transducers are required for the current needs of NDT applications this book gives a consolidated account regarding the basic principles applications advantages and limitations design considerations materials and methods used for their evaluation and calibration etc by the technocrats and professionals involved in ultrasonic NDT

Ultrasonic Transducers K Nakamura, 2012-08-23

Ultrasonic transducers are key components in sensors for distance flow and level measurement as well as in power biomedical and other applications of ultrasound Ultrasonic transducers reviews recent research in the design and application of this important technology Part one provides an overview of materials and design of ultrasonic transducers Piezoelectricity and basic configurations are explored in depth along with electromagnetic acoustic transducers and the use of ceramics thin film and single crystals in ultrasonic transducers Part two goes on to investigate

modelling and characterisation with performance modelling electrical evaluation laser Doppler vibrometry and optical visualisation all considered in detail Applications of ultrasonic transducers are the focus of part three beginning with a review of surface acoustic wave devices and air borne ultrasound transducers and going on to consider ultrasonic transducers for use at high temperature and in flaw detection systems power biomedical and micro scale ultrasonics therapeutic ultrasound devices piezoelectric and fibre optic hydrophones and ultrasonic motors are also described With its distinguished editor and expert team of international contributors Ultrasonic transducers is an authoritative review of key developments for engineers and materials scientists involved in this area of technology as well as in its applications in sectors as diverse as electronics wireless communication and medical diagnostics Reviews recent research in the design and application of ultrasonic transducers Provides an overview of the materials and design of ultrasonic transducers with an in depth exploration of piezoelectricity and basic configurations Investigates modelling and characterisation applications of ultrasonic transducers and ultrasonic transducers for use at high temperature and in flaw detection systems Publications of the National Institute of Standards and Technology ... Catalog National Institute of Standards and Technology (U.S.),1983

**NBS Special Publication** ,1968 *Investigation of a Novel Transducer Design for Ultrasonic Non-destructive Testing of Additively Manufactured Metal Components* Michael Ryan Costa,2021 Additively manufactured AM components have seen increased use in industry in recent years AM is of particular interest in aerospace where high specific stiffness and strength of structural components is desired AM helps to achieve this goal by adding the capability of manufacturing highly optimized geometry that is not possible or economic with traditional manufacturing methods With the new processes associated with AM come new challenges for performing non destructive testing NDT as well as qualifying parts for flight use There are current gaps in NDT processes and technologies with how they can be applied to AM Current ultrasound NDT systems are not optimized for AM parts Ultrasonic transducers are generally too large or do not have the reach to access small features on parts with complex geometry This research investigates the use of ultrasonic NDT on AM parts using a novel transducer design with a probe like implement designed to gain access to small features that commercial transducers are currently incapable of accessing A Langevin type ultrasonic transducer is designed and manufactured Finite element analysis FEA is conducted on complex parts in order to determine the feasibility of inspecting components of high complexity by using guided wave ultrasonic NDT techniques FEA studies show feasibility regarding using guided waves in the 650 kHz range to detect void type defects in a complex part Multiphysics simulations are employed to provide insight into transducer behavior A multiphysics study is used to produce a frequency response plot which shows general correlation to real world data from the experimental transducer The transducer s frequency response in the 50 kHz to 650 kHz domain is characterized and NDT experiments are conducted using plates and an AM component Testing of an AM part showed better performance for detecting potential flaws under experimental settings when using prescribed damage indices Results are compared to the

performance of a commercial transducer under the same experimental conditions Damage indices are developed in order to create a low detection threshold The experimental transducer is successfully used in detecting a stiffener within a plate with calculated damage indices being comparable to a commercial transducer Ultrasonics Dale Ensminger, Foster B. Stulen, 2008-12-17 Gain a Unique and Comprehensive Understanding of Ultrasonics Despite its importance most books on ultrasonics cover only very specific sub fields of the science They generally also take a more mathematical approach and lack the wider scope needed to truly improve understanding and facilitate practical use of ultrasonics across a wide range of disc

**Publications of the National Bureau of Standards** United States. National Bureau of Standards, 1982 *High Temperature Integrated and Flexible Ultrasonic Transducers for Nondestructive Testing* Makiko Kobayashi, C. K. Jen, Jean F. Bussiere, Industrial Materials Institute (Canada), Institut des materiaux industriels (Canada), 2008 **New Developments in Ultrasonic Transducers and Transducer Systems** Frederic L. Lizzi, 1992 *Nondestructive Testing* Louis Cartz, 1995 **Nondestructive Testing Overview** Stanley Ness, Charles N. Sherlock, 1996 **New Developments in Ultrasonic Transducers and Their Application to Nondestructive Testing** J. C. BACON, 1961 **Industrial Radiography and Non-destructive Testing**, 1997 **British Journal of Non-destructive Testing**, 1993 **Advanced Nondestructive Evaluation for Structural and Biological Health Monitoring**, 2001 **Ultrasonic Transducer Arrays for Nondestructive Testing** Richard Lawrence Baer, 1983 *Nondestructive Testing Techniques for Structural Composites*, 1989 **Development of Nondestructive Test Techniques for Multidirectional Fiber-reinforced Resin Matrix Composites** John L. Cook, 1971

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