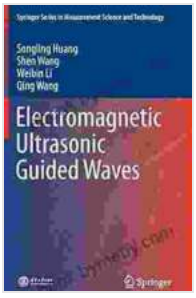
Electromagnetic Ultrasonic Guided Waves: A Powerful Tool for Condition Monitoring and Structural Health Monitoring

Electromagnetic ultrasonic guided waves (EUGWs) are a type of acoustic wave that is generated and propagated in a solid material by the interaction of an electromagnetic field with the material's elastic properties. EUGWs have a number of unique characteristics that make them well-suited for condition monitoring and structural health monitoring (SHM) applications. First, EUGWs are highly sensitive to changes in the material's properties, such as cracks, corrosion, or delamination. Second, EUGWs can propagate over long distances in a material, making them well-suited for monitoring large structures. Third, EUGWs can be generated and detected using non-contact methods, making them ideal for use in harsh or inaccessible environments.



Electromagnetic Ultrasonic Guided Waves (Springer Series in Measurement Science and Technology)

by Karen Bush

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Text-to-Speech	: Enabled
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Screen Reader	: Supported

Theory of Electromagnetic Ultrasonic Guided Waves

The theory of EUGWs is based on the interaction of an electromagnetic field with the elastic properties of a material. When an electromagnetic field is applied to a material, it causes the material to vibrate. The frequency of the vibration is determined by the frequency of the electromagnetic field and the elastic properties of the material. If the frequency of the electromagnetic field is high enough, the vibration will generate an ultrasonic wave.

The propagation of EUGWs in a material is governed by the wave equation. The wave equation is a partial differential equation that describes the propagation of waves in a medium. The wave equation for EUGWs can be solved to obtain the dispersion relation, which is a relationship between the wave velocity and the frequency of the wave. The dispersion relation for EUGWs is typically complex, meaning that the wave velocity depends on both the frequency of the wave and the material's properties.

Generation and Detection of Electromagnetic Ultrasonic Guided Waves

EUGWs can be generated using a variety of methods, including piezoelectric transducers, electromagnetic acoustic transducers (EMATs),and laser-induced ultrasound. Piezoelectric transducers are the most common type of transducer used to generate EUGWs. Piezoelectric transducers convert electrical energy into mechanical energy, which is then used to generate EUGWs in the material. EMATs are non-contact transducers that use the interaction of an electromagnetic field with the material's elastic properties to generate EUGWs. Laser-induced ultrasound is a non-contact method for generating EUGWs using a pulsed laser.

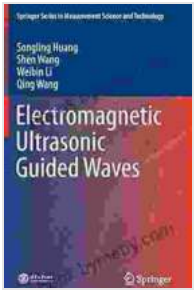
EUGWs can be detected using a variety of methods, including piezoelectric transducers, EMATs, and laser-induced ultrasound. Piezoelectric transducers are the most common type of transducer used to detect EUGWs. Piezoelectric transducers convert mechanical energy into electrical energy, which is then used to generate an electrical signal that can be processed to extract information about the EUGWs. EMATs are non-contact transducers that use the interaction of an electromagnetic field with the material's elastic properties to detect EUGWs. Laser-induced ultrasound is a non-contact method for detecting EUGWs using a pulsed laser.

Applications of Electromagnetic Ultrasonic Guided Waves

EUGWs have a wide range of applications in condition monitoring and SHM. Some of the most common applications include:

* Crack detection * Corrosion detection * Delamination detection * Structural integrity assessment * Aerospace applications * Energy applications * Manufacturing applications

EUGWs are a powerful tool for condition monitoring and SHM. They are highly sensitive to changes in the material's properties, they can propagate over long distances in a material, and they can be generated and detected using non-contact methods. EUGWs have a wide range of applications in various industrial sectors, including aerospace, energy, and manufacturing.



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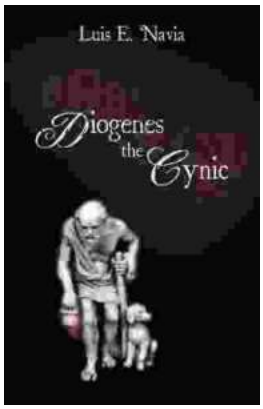

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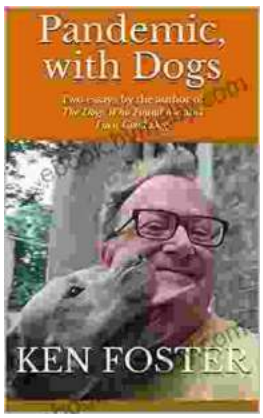

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