IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

METHOD AND SYSTEM FOR DETERMINING MATERIAL PROPERTY OF SAMPLE USING EDGE WAVEFRONT SIGNAL

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Acoustic microscopy** is a method used for material characterization of **metallic and biological samples** by generating **surface waves using a single transducer in pulse echo mode**.
- The energy leaks back into the coupling fluid, and the **surface wave velocity is determined by analyzing interference.**
- Ultrasonic waves can be focused using a **lens or a 30 lens-less approach** using a flexible piezo polymer element like Polyvinylidene Fluoride **(PVDF).**
- Edge waves can **degrade image quality in high-frequency imaging applications**.
- **Matching the transducer's aperture angle** with the material's critical angles is necessary.
- There is a **need for an improved system** and method for **improving material imaging** and characterization, **especially in situations** where **conventional ultrasound methods** are limited.

TECHNOLOGY CATEGORY/ MARKET

Technology: Determining material property using edge wave front signal
Category: Advance Material & Manufacturing
Industry: Material Science
Application: Non-destructive Testing (NDT), Acoustic microscopy, Material characterization, 2D-FFT**.**
Market: The global market size of valued at **USD 14.28 billion in 2022** and is projected to grow from **USD 15.78 billion in 2023 to USD 33.73 billion** by **2030,** exhibiting a **CAGR of 11.5%** during the forecast period.

INTELLECTUAL PROPERTY

IITM IDF Ref. 2420 Patent No: IN 540337 , PCT /IN2023/050886

TRL (Technology Readiness Level)

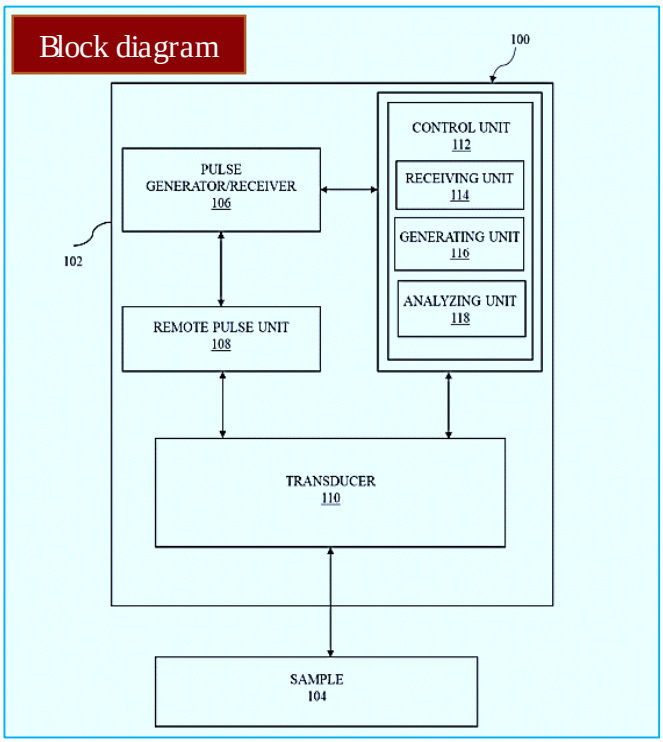
TRL-4, Experimentally validated in Lab;

Research Lab

Prof. Krishnan Balasubramanian,
Dept. of Mechanical Engineering

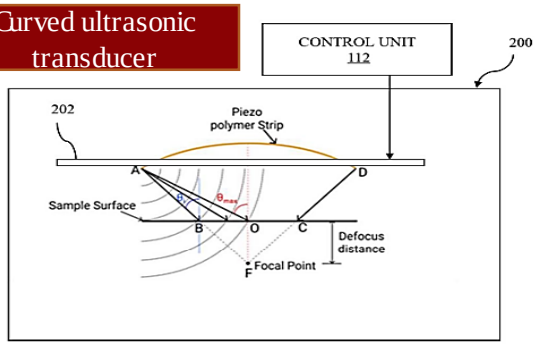
TECHNOLOGY

Block diagram



The above block diagram illustrates environment architecture for acoustic microscopy arrangement for determining material property of a sample using edge wavefront signal

Curved ultrasonic transducer



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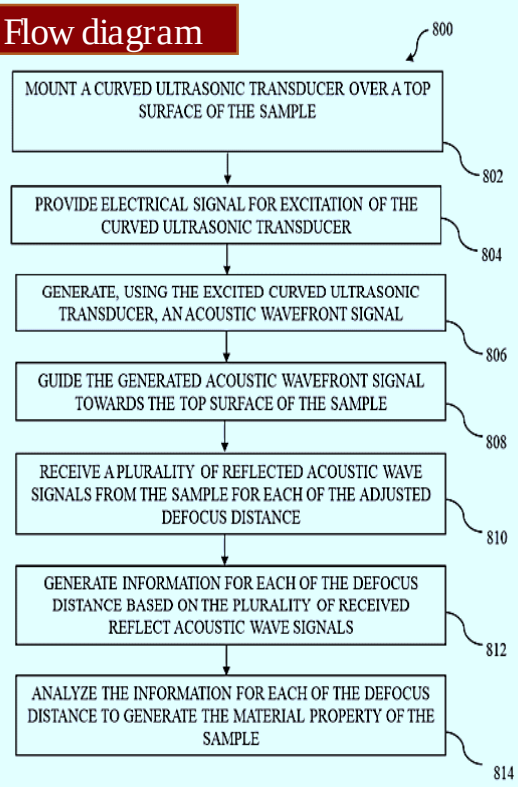
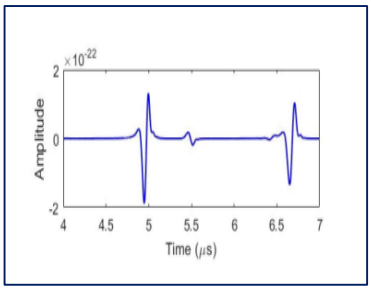
Flow diagram



Identification of modes based on the curves

1



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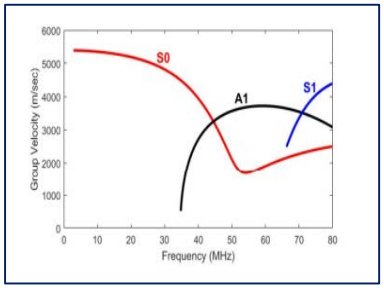

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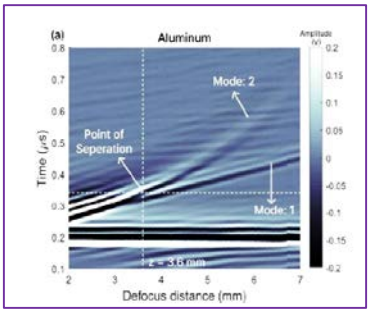

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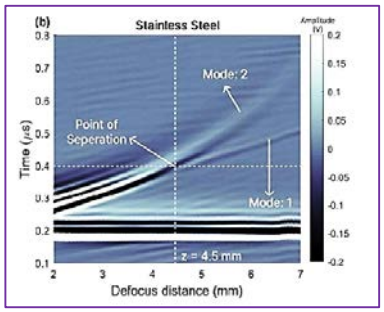

Key Features / Value Proposition

- **Techniques**
  - an **acoustic wavefront signal** that includes an acoustic wavefront signal and
  - receive a plurality of **reflected acoustic wave signals from the sample** for each of the **adjusted defocus distance** and
  - generate information for each of the defocus distance based on the plurality of **received reflect acoustic wave signals**.
  - Sequentially, the **control unit is configured** to **analyze the information** for each of the **defocus distance to determine the material property** of the sample.
- **Control unit**
  - To **control incident angle** of the acoustic wavefront signal of the curved ultrasonic transducer
  - based on the **element diameter** and focal length of the transducer.
  - generate **surface velocity of the sample based the generated plurality of curves**
- **Remote pulse unit**
  - It is **operatively coupled to the pulse generator/receiver** and configured to amplify the electrical signal sent to the curved ultrasonic transducer for excitation
- **A non-transitory computer-readable medium**
  - It **stores instructions**
  - It involves **mounting a curved ultrasonic transducer** on a sample's top surface, providing an electrical signal for excitation,
  - generating an **acoustic wavefront signal**, guiding it towards the sample, adjusting defocus distance, receiving reflected signals,
  - generating information for **each defocus distance**, and analyzing the information to determine the sample's material properties.
  - **comparing wave property of modes in the curve with a predefined wave property** of modes present in the database of the system
- **Performance**
  - Includes **mounting a curved ultrasonic transducer** over a top surface of the sample such that the curved ultrasonic transducer is adjustable in **3 dimensions.**
  - This method ensures **accurate and reliable results.**

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