IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

System and Method for Ultrasonic Inspection of Curved Surfaces

IITM Technology Available for Licensing

Problem Statement

- **Pulsed Array Ultrasonic Transducers** (**PAUT**), an existing **ultrasonic testing method** rely on multiple transducers and intricate electronic systems, resulting in **complexity, potential limitations in inspecting materials with curved portions, higher costs** and may limit its applications in diverse fields.
- The existing ultrasonic testing methods, including **advancements like curved array probes and conformable array transducers**, often come with inherent **complexities & costs**.
- Hence, there is a growing demand for a **more simpler, streamlined and cost-efficient solution for ultrasonic inspection**, especially for hollow structures to overcome the limitations of current technology.

Technology Category/ Market

Non-Destructive Testing Methods and Equipment (NDT/NDE) | Other Technologies

Industry: Manufacturing & Fabrication Industry, Healthcare, Aerospace, Oil and Gas Industry, Construction and Infrastructure Industry

Applications: Ultrasonic Inspection Technology, Non-Destructive Testing, Biomedical Ultrasound Imaging, Industrial Inspection Market

Market: The global ultrasonic testing market size is projected to grow from **$ 1,954.4 million in 2020** and to reach **$3,671.9 million by 2027,** growing at **9.43% CAGR** from **2020 to 2027.**

Technology

The present patent invention aims to disclose a System and Method to streamline and cost-effectively improve **ultrasonic inspection for curved surfaces**, ensuring high-quality evaluations, especially in hollow structures and materials with curved portions.

Intellectual Property

IITM IDF No.: **1729** | IP No.: **402425 (Granted)**

TRL (Technology Readiness Level)

TRL-3: Proof of Concept

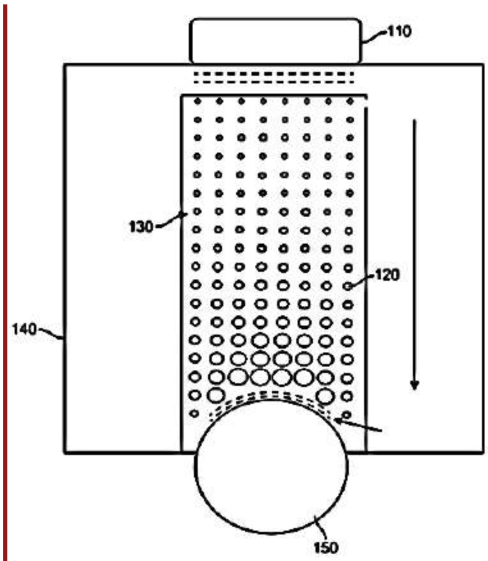

FIG. 1 Shows a system for ultrasonic inspection of curved surface.

FIG. 2 Shows a method for ultrasonic inspection of curved surface

1. Provide an ultrasonic transducer to transmit and receive ultrasonic waves
2. Position a holey plate between the transducer and the object
3. Provide the plate with a pattern of inclusions to generate a wave front having curvature corresponding to the curved surface of the object to be inspected
4. Emit a beam of ultrasonic radiation from the transducer on the plate
5. Penetrate the object with the curved wave front
6. Receive reflected waves characteristic of the object via the holey plate at the transducer

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Key Features / Value Proposition

User perspective:-

- **Simplicity and Ease of Use:** User-friendly design and operation for easy implementation and reduced training requirements.
- **High-Quality Inspections:** Ensures accurate and reliable inspection results for curved surfaces without compromising quality.

Industrial perspective:-

- **Cost-Effective Solution:** Reduces overall costs associated with ultrasonic inspection by eliminating need for multiple transducers and complex electronics.
- **Versatility:** Applicable across various industries, offering a versatile solution for inspecting curved surfaces in different materials and structures.

Technology perspective:-

- **Single Transducer Efficiency:** Utilizes a single transducer for generating curved wave fronts, simplifying the technology and reducing complexity.
- **Customization with GRIN PCs:** Incorporates Gradient Refractive Index Phononic Crystals (GRIN PCs) for tailored wave front curvature, enhancing customization capabilities.

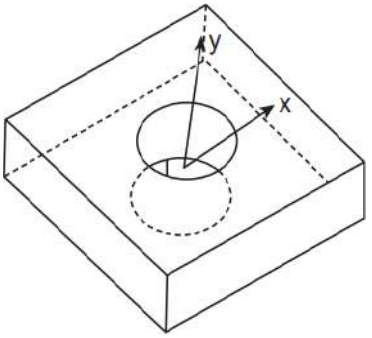


FIG. 4 shows the square unit cell having a circular shape inclusion with air medium

FIG. 5A shows A-scan plot of the inspected curved surface when the emitted ultrasonic wave passes through the holey plate.

FIG. 5B shows A-scan plot of the inspected curved surface when the emitted ultrasonic wave passes through a solid plate.

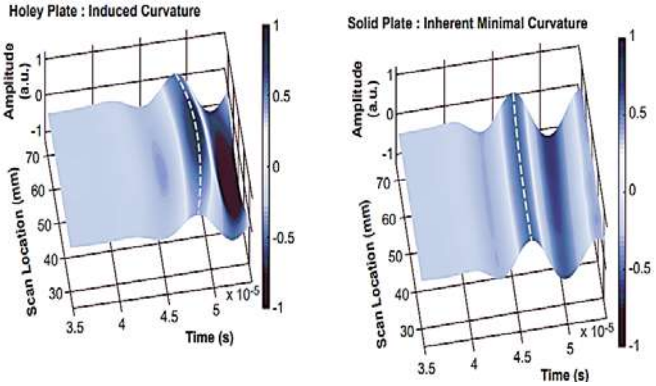
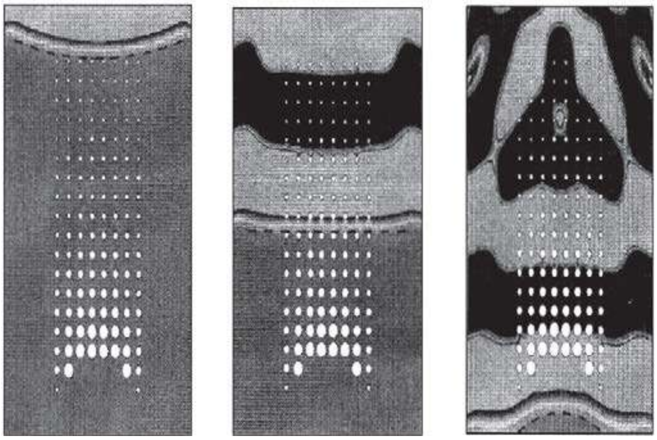


FIG. 6A shows a wave front before passing through a holey region;

FIG. 6B shows the wave front while passing through the holey region;

FIG. 6C shows the wave front after passing through the holey region.



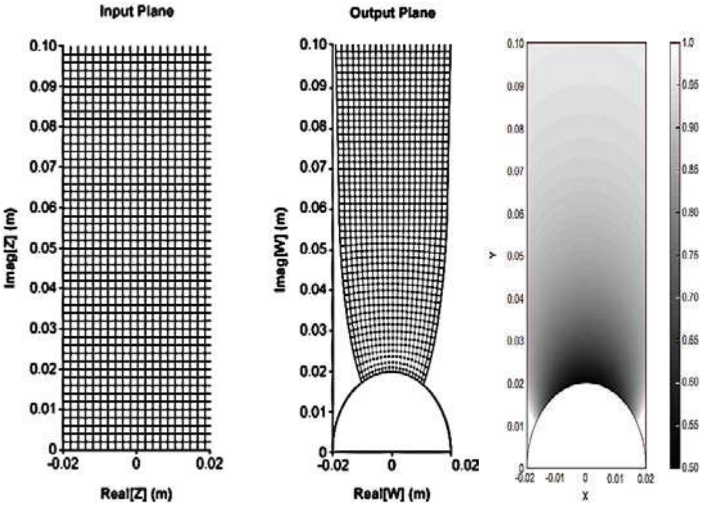


FIG. 3A shows **parallel grid lines in virtual space**;

FIG. 3B shows **transformation of parallel grid lines in virtual space to a curved lines** in physical space.

FIG. 3C shows the **ratio of velocity** required in the holey region to velocity of the wave in base medium.

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