STAIRCASE SHAPED MAGNETOSTRICTIVE PATCH (ScaMP) TRANSDUCER

IITM Technology Available for Licensing

Problem Statement

- In magnetostrictive patch transduction, the patch dimension in the direction of wave propagation influences its frequency response.
- Generally, the **patch-width must be equal to half the wavelength** of the wave produced.
- However, in conventional magnetostrictive patch transducers, the **selection of patch width effects the sensor's frequency response**, the excitation of guided waves occurs in a narrow bandwidth.
- Despite certain advantages such as **better sensitivity and signal to noise ratio**, the scope of applications where a narrowband magnetostrictive patch transducer can be used is limited due to limited frequency response.
- There is therefore a need for magnetostrictive patch (MP) transducers that overcome the limitations and **provide a broadband frequency response.**

Technology Category/ Market

Category- Non-destructive evaluation (NDE), Structural Health Monitoring

Applications - Ultrasonic wave inspection/ monitoring methods, long-term corrosion monitoring and suitable for leave-in-place sensor applications in a Structural Health Monitoring mode.

Market - Magnetostrictive Material Market size is forecast to reach $25.2 billion by 2025, after growing at a **CAGR of 8.6%** during 2020-2025.

Technology

- The proposed Staircase Magnetostrictive Patch(ScaMP), constructed like a staircase, contributes to the **transducer's wide-banded frequency response**.
- The width and length of each step are to be selected in such a way that it will all have the **same area exposed to the magnetic field.**
- The number of steps and widths can be chosen based on the required frequency coverage.
- The ScaMP has a staircase-like structure/shape comprising **a plurality of steps 202a-202n, each step having a corresponding patch-width Ws1-Wsn as shown in Figure 1.**
- Additionally, ScaMP can excite inside the designated frequency band in relation to the excitation frequency bandwidth if the corresponding step width was taken into account during design.
- The **user can employ the frequency-sweep strategy as necessary** because ScaMP on the other hand will be able to excite individual narrowband frequencies in accordance with the steps included.

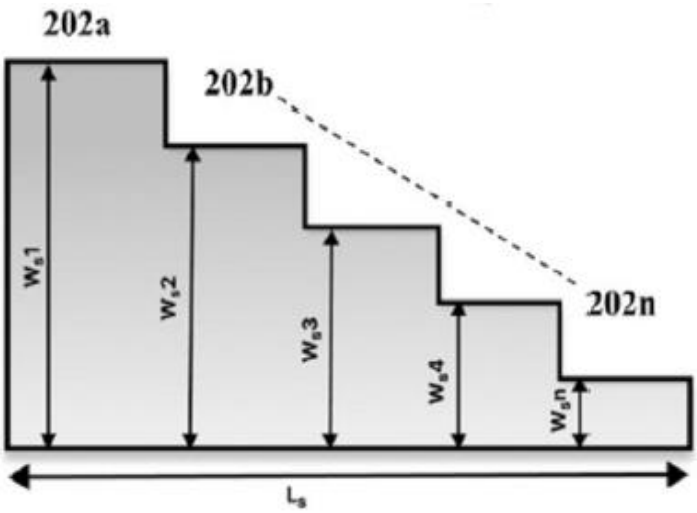

Fig. 1. depicts a schematic representation of a magnetostrictive patch having a staircase shape.

Intellectual Property

- IITM IDF Ref. **2455**
- **IN 202241070456**

TRL (Technology Readiness Level)

TRL - 4, Experimentally validated in lab.

Research Lab

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Industrial Consultancy & Sponsored Research (IC&SR)

Key Features / Value Proposition

- The proposed ScaMP transducer can **cover a wide range of remnant thickness** utilizing the cut-off property of higher-order guided wave modes.
- ScaMP transduction can be used to execute both frequency-sweep and broadband frequency approaches **without altering the inspection setup**.
- Since, the magnetostrictive material compositions can withstand higher temperatures (up to 500 C), the ScaMP technique may also find applications for **long-term corrosion monitoring** in process industries.

1. Mount a pair of magnetostrictive patch (MP) transducers on a test sample comprising one or more defects, at a predefined distance from one another.
2. Excite the transmitting MP transducer to generate ultrasonic waves at one or more frequencies.
3. Propagate the generated ultrasonic waves through the test sample.
4. Measure a variation of dispersion characteristics of the ultrasonic waves received from the receiving MP transducer.
5. Detect the one or more defects in the test sample based on the measured variation.

Fig.2. a flowchart depicting an exemplary method for detecting defects using the ScaMP transducer.

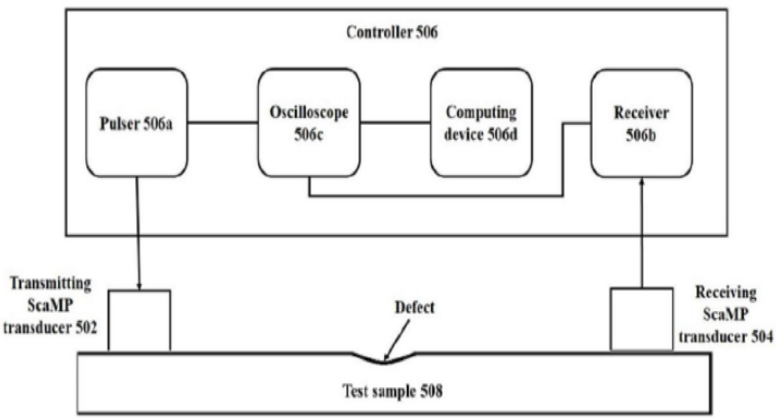

Fig. 3. depicts an exemplary apparatus for defect detection using ScaMP transducer.

Technology Contd.

- A method for **detecting defects in a test sample** is shown in Figure 2. The apparatus depicted in Figure 3 may further be employed for detecting/measuring defects in a test sample.
- Further, the controller may measure and/or detect the one or more defects in the test sample based on a variation of the dispersion characteristics of the ultrasonic waves received by the controller from the receiving ScaMP transducer.
- Figure 4 presents experimental outcomes from the broadband and frequency-sweep techniques. The spectrogram results of 6 mm, 4mm, and 2mm remnant thickness defects obtained using broadband excitation are shown in Figures 4 (a), 4(c) and 4(e) respectively.
- Further, the spectrogram results of 6 mm, 4mm, and 2mm remnant thickness defects obtained using frequency-sweep are shown in Figures 4(b), 4(d), and 4(f).

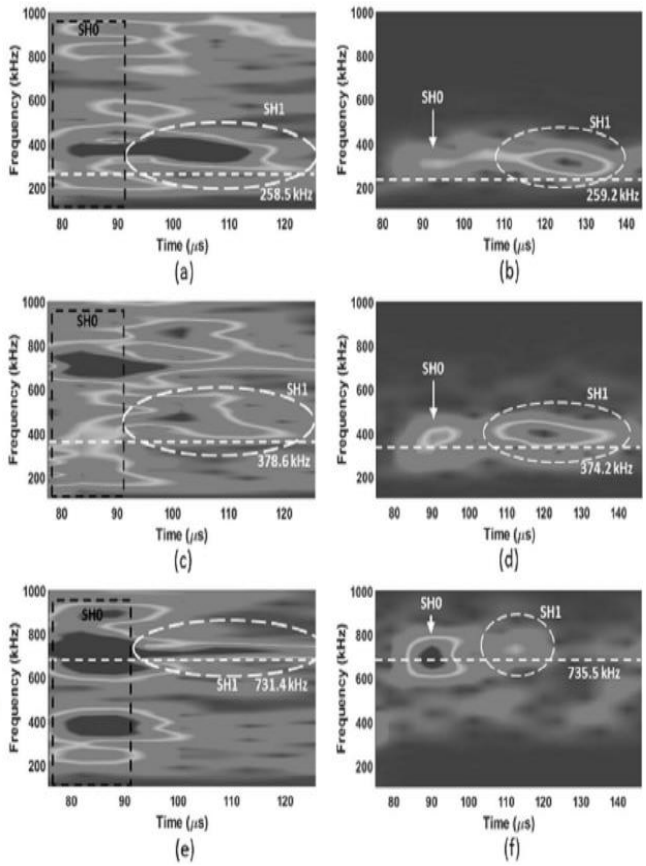

Fig. 4. (a)-(f) depicts experimental spectrogram results.

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