

STAGGERED MAGNET ARRAY (SMA) BASED ELECTROMAGNETIC ACOUSTIC TRANSDUCER (EMAT)

IITM Technology Available for Licensing

Problem Statement

- In the present era, the design of EMATs enable users to generate specific wave modes & the ultrasound is produced immediately below the surface of the inspected specimen having various issues.
- There is a need for an improved staggered magnet array (SMA) based electromagnetic acoustic transducer (EMAT) system for **controlling** the direction of **ultrasonic wave** depending on the industrial application & also, a need exists for a SMA based EMAT system & method for **controlling** the direction of the ultrasonic waves in the EMAT using SMA configurations. Present invention provides the solution in efficient manner.

Technology Category/ Market

Technology: Staggered magnet array (SMA) based electromagnetic acoustic transducer (EMAT);

Industry & Application: Nondestructive testing & Medical imaging, Automotive, Pipeline, Aerospace, others;

Market: The global Electromagnetic Acoustic Transducer(EMAT) market size is expected to grow at a **CAGR** of **7.5%** from 2024 to **2030**.

Technology

- Claimed patent describes a staggered magnet array (**SMA**) based electromagnetic acoustic transducer (**EMAT**) system. The system comprises:

1. at least **one** **conductive racetrack coil**; &

2. at least **two magnet arrays** comprises of permanent magnets, where each magnet is oriented according to a specific hybrid configuration having at least one of **periodic permanent magnet (PPM)** & **linear Halbach array magnet (HBA) configuration** to **produce different ultrasonic waves** in order to form an

different **ultrasonic beam** by mechanical movement for shifting the position of at least one magnet in the magnet arrays of PPM & HBA configuration in up or down direction to creating a SMA configuration at **fixed frequency**, shown in Fig. 1.

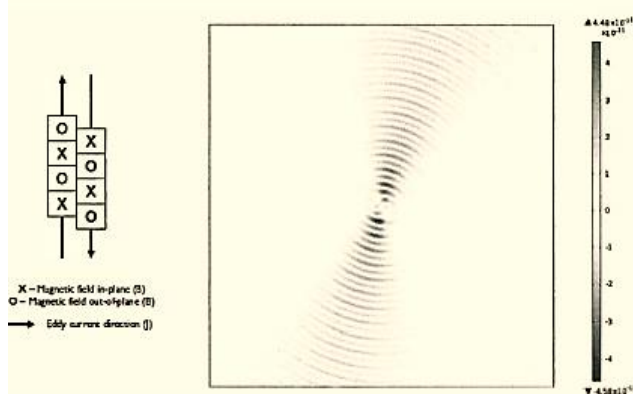


Fig. 1 depicts a graphical representation of the staggered magnet array (2 array) PPM EMAT & the SH waves generated using the staggered 2 array PPM EMAT where 2nd magnet array is shifted down by wavelength ($\lambda/8$).

- Further, a multiple magnet arrays EMAT for beam forming comprises: 2 array EMAT configuration, 3 array EMAT configuration, 4 array EMAT configuration, 5 array EMAT configuration & multi-array EMAT configuration. (Refer Fig.2)

Intellectual Property

IITM IDF Ref. 1925; IN Patent No. 512822
PCT Application No. PCT/IN2020/050936
US Publication No. US-2023-0018319-A1

TRL (Technology Readiness Level)

TRL-4, Technology validated in Lab

Research Lab

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Images

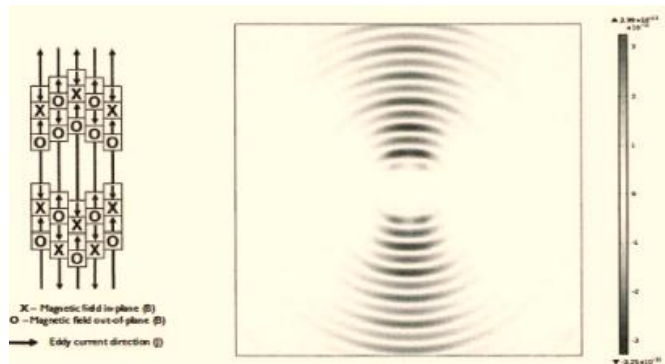


Fig 2. Depicts a graphical representation of multiple staggered magnet array section HBA EMAT & the SH waves generated using multiple staggered magnet array section HBA EMAT

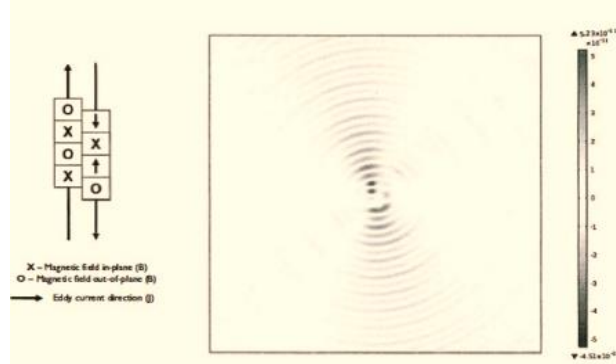


Fig. 3 shown a graphical representation of the staggered magnet array (2 array) hybrid (PPM-HBA) EMAT & the SH waves generated using the staggered 2 array magnet array shifted down 5 mm (wavelength $(\lambda/4)$ for PPM and wavelength $(\lambda/8)$ for Halbach)

Key Features / Value Proposition

Enhanced Performance:

- The proposed **system** provides the **SMA based EMAT** allows for the **dynamic or static focusing or defocusing of ultrasonic beams** and thereby **enhance the results or data obtained** in the **industrial application**.

Handy by the Operator:

- Proposed system allows the **operator to steer the beam at different angles** using a **single transducer**.

Universal Economical Solution:

- The SMA based EMAT prototype can have **small footprint, low cost**, and offer a universal solution for **producing static or dynamic beam forming** through simple mechanical movement of the magnets.

Other Important Features:

- The magnetic configurations in the SMA based EMAT system can be **dynamically manipulated** through the mechanical movement of the **magnet arrays**, thereby **manipulating the ultrasonic beams** from the EMAT.

Experimental Setup Details:

- The setup contains both **PPM and Halbach array**, the chosen **EMAT frequency was 118 kHz**, which was the midpoint frequency between **80 kHz and 156 kHz**. (Shown in Figure)

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