# Rayleigh wave Positioning System (RaPS)
## IITM Technology Available for Licensing

## PROBLEM STATEMENT

- Conventional manual ultrasonic field inspection of components such as pipeline systems find limitations when applied to the pipelines components.
- The limitations are due to the presence of blind spots for RF & visual techniques, &
- Further limitation is the interference of the fields as well as dynamic flux effects from the metal components when using RF and magnetic methods.
- Moreover, the process is costlier and not realistic in applications. Hence, there is a need to address the issues.

## INTELLECTUAL PROPERTY

**IITM IDF Ref. 1571; IN Patent No: 484257**
**PCT Application No. PCT/IN2018/050474**

## TECHNOLOGY CATEGORY/ MARKET

**Technology:** Rayleigh wave Positioning System; **Industry & Application:** Magnetic Positioning systems, video monitoring systems pipeline applications ;
**Market:** The global acoustic wave sensors market is projected to grow at a **CAGR** of **16.28%** during **2024-2030.**

## TRL (TECHNOLOGY READINESS LEVEL)

**TRL-4**, Proof of Concept ready, tested in lab.

## TECHNOLOGY

- Present invention describes a **positioning system** for providing a **real time update on an estimated positioning of an ultrasonic probe in a 3D component.**
- The system discloses a provision for real-time update on the estimated positioning of an ultrasonic inspection probe in a 3D surface of the part along with a triangulation algorithm/system.
- An **ultrasonic guided wave** in the form of a **Rayleigh wave mode** is generated in an "**omni direction**" manner.

## IMAGE

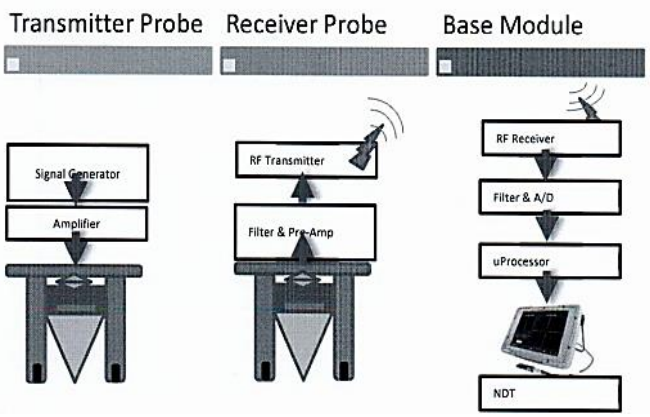


**FIG.1: Illustrates the perspective view of electronics modules representation of the system; .**

- This **generator** is **co-located** along with the ultrasonic inspection probe & is excited using a simple electronic circuit that generated a **time limited sinusoidal/square wave pattern.**
- The wave travels along the surface of the pipe & is detected by **2-6 or more optimally located receiver probes.**
- Using the relative time of arrival of the waves in the received probes, & by knowing the **Rayleigh velocity** in the case of Rayleigh guided waves & the geometry of the **pipe**, the **position of the transmitter** will be determined.
- The **receiver probes** are physically attached to the surface of the pipe & at locations that are optimized apriori.
- Additionally, a simplified calibration procedure will be developed in order to compensate for any variations in the velocity of the Rayleigh waves (guided wave) due to environmental conditions.

## RESEARCH LAB

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## TECHNOLOGY (Contd.)

- The system comprises of the following:

a) **positioning an ultrasonic generator** near an inspection probe in the 3D surface;

b) generating **an ultrasonic guided wave** in the generator in the form of guided wave mode which is generated in an "omni – direction" which guided waves travel along the surface of the 3D component.

c) positioning a **plurality of ultrasonic receiver probes** along the length of the 3D component at specific points based on **a selective calculation** of optimized apriori. (Refer Figure hereinbelow)

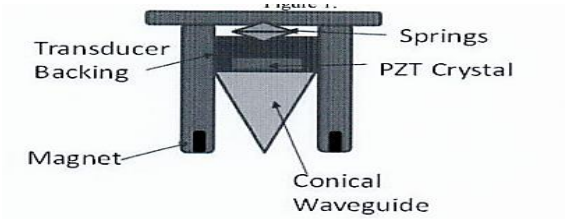


**Fig. 2: Depicts Preliminary design of the transmitter/receiver probe;**

## KEY FEATURES / VALUE PROPOSITION

### ❖ *Technical Perspective:*

- Present invention facilitates a **positioning system** consisting a **plurality of three transmitter & receiver probes**, wherein the **receiver probes** are magnetically attached to the surface of the pipe & are adapted to transmit the waves into a **conical wave guide**.
- The **transmitter probes** consisting of a **PZT crystal** which are **different** from the PZT crystal in **receiver probes**.
- The **receiver probes** transmit **waves** which will **produce a point source** or an **annular line source** on the pipe. (Refer figure)
- There is no interferences from adjacent structures including the operator or the ultrasonic instrument.
- There are **low footprint** with the transmitters & receivers all positioned on the pipeline component.
- There is **low power requirements (battery operated).**
- The Modular and configurable modules providing flexibility during implementation.

### Industrial Perspective:

- Provides **Cost-effective System.**
- Use of ultrasound generators & receivers those are **non-ionising & Safe**.
- There is **minimal training requirements** since operators are already trained in ultrasound inspection.
- Present invention can be extended to other type of guided waves such as **Lamb Guided modes, interface guided modes,** etc.

## IMAGE

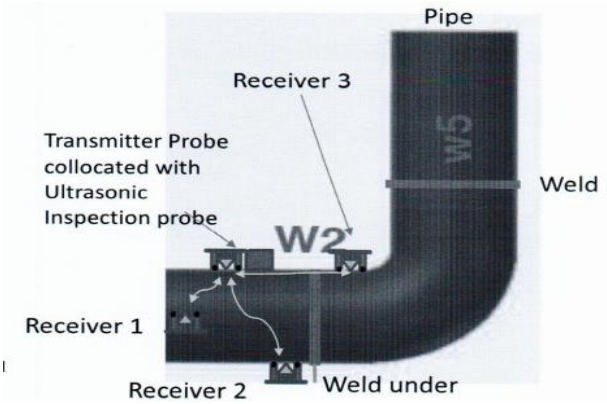


**Fig. 3: depicts schematic representation of the Rayleigh wave position sensing system on a typical pipeline component.**

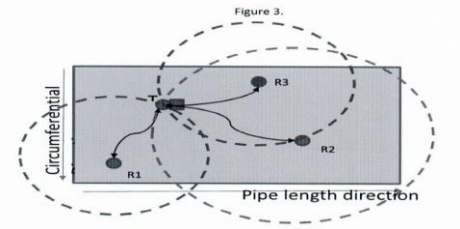


**FIG 4: Illustrates schematic representation of the positioning algorithm based on 3 receivers.**

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