IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

NON-CONTACT ANGLE SENSOR BASED ON EDDY CURRENT TECHNIQUE

IITM Technology Available for Licensing

Problem Statement

- Existing angle sensors in automotive and robotic industries face limitations such as wear and tear, sensitivity to harsh environments, and the need for mechanical/electrical contact.
- There is a demand for a reliable and low-cost angle sensor with non-contact measurement capabilities suitable for dusty and harsh environments.
- Current technologies, including capacitive, magnetic, and optical sensors, have drawbacks, highlighting the need for an innovative solution like an eddy current-based angle sensor with a wide detecting range of 0 to 360 degrees.

Intellectual Property

- IITM IDF Ref. **1833**
- **IN 494698 - Patent Granted**

TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

Technology Category/ Market

Category - Sensor Technology
Applications-Automotive Steering Angle Sensors, Robotic Arm Positioning Systems
Industry- Automotive Manufacturing, Industrial Automation, Robotics

Market - Global automotive steering system market was valued at USD 36.33 billion in 2023 and is expected to grow at a **CAGR of 2.4%.**

Research Lab

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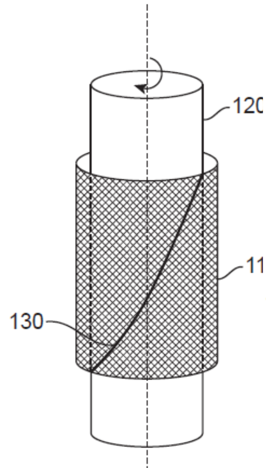

FIG. 1A

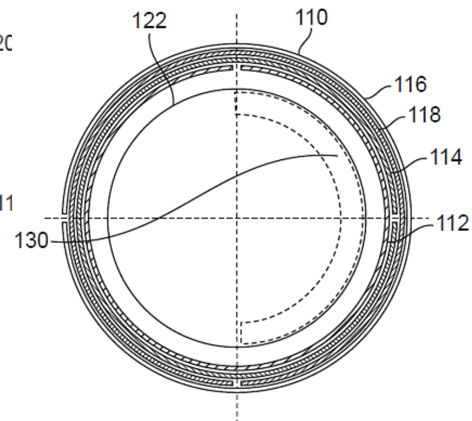

FIG. 1B

FIG. 1A illustrates an eddy current based non-contact sensor having a stationary coil assembly and a rotary component.
FIG. 1B illustrates a cross-sectional view.

Technology

- **An eddy current-based non-contact sensor is designed with a stationary cylindrical coil assembly and a rotary component, enabling detection of angular displacement without physical contact.**
- **The rotary component features a helical groove on its surface, causing a change in the effective inductance of the coils as it rotates, which is measured to determine the angular displacement.**
- **A signal conditioning circuit processes this change to generate an output signal proportional to the displacement, incorporating an algorithm to identify the quadrant in which the groove overlaps.**

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Key Features / Value Proposition

1. Non-Contact Angular Displacement Sensing:

- **Offers precise measurement without physical contact, minimizing wear and tear issues common in conventional sensors.**

2. Enhanced Durability

- **Utilizes eddy current technology, ensuring reliable performance even in dusty, moist, or greasy conditions prevalent in automotive and robotic applications.**

3. High Sensitivity and Resolution

- **The method offers high sensitivity (0.0125 V/degree or lower) and resolution (0.08° or lower) with repeatability error of 0.02% or lower.**

4. Compact and Versatile Design:

- **Features a cylindrical coil assembly with overlapping planar coils and a rotary component, offering a compact solution adaptable to space-constrained environments.**

5. Quadrant Identification Algorithm:

- **Incorporates an algorithm to precisely identify the quadrant of angular displacement, enhancing measurement accuracy and reliability.**

Method

Provide sensor system having a stationary cylindrical coil assembly having 4 flexible overlapping planar coils

↓

Provide a conductive cylindrical hollow shaft with a helical groove within the stationary coil assembly

↓

Energize the planar coils cyclically in sequence by the voltage source to produce a time-varying magnetic field

↓

Cause the rotary component to develop an eddy current on an outer surface thereof as a function of the time-varying magnetic field produced in the coils

↓

Provide an angular displacement to the shaft with respect to the stationary component

↓

Measure change in effective inductance of the coils through overlap of the groove by the coils as a function of the displacement.

↓

Compute the angular displacement from the change in effective inductance

FIG. 2 illustrates a method of detecting displacement of an object using a noncontact sensor system.

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