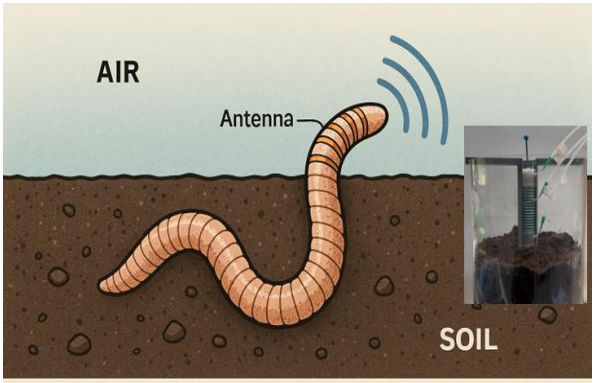
Design of antenna integrated soft robotic worm for soil to air communication.

Short summary :- Design, prototype and evaluate a small soft robotic worm that can traverse soil and wirelessly communicate sensed data to a surface receiver. The robot should integrate a soil-robust antenna (filtenna or small monopole/loop) and low-power telemetry, while maintaining soft-robot locomotion and survivability in varying soil conditions. Demonstrate proof-of-concept lab tests showing mobility, communication range, and sensing (e.g., moisture or temperature).



ANTENNA INTEGRATED SOFT ROBOTIC WORM FOR SOIL TO AIR COMMUNICATION

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Start date : - Flexible (Will decide after discussion)

Disciplines:- Soft robotics, Antenna/RF engineering, Environmental sensing

Main objectives

- Soft robot design & fabrication: Create a small soft robotic worm capable of inchworm/undulatory/peristaltic locomotion in loose soil or controlled phantoms.
- Integrated antenna design: Design an antenna or filtenna compatible with burial (chosen band 433/868 MHz or 2.4 GHz depending on size/penetration tradeoff) and integrate it mechanically/electrically with the soft body.
- Electronics & comms: Implement a low-power sensing and transmit system (microcontroller + transceiver), with duty-cycling suitable for exploratory use.
- Experimental validation: Test mobility, communication (RSSI, packet loss), and sensing accuracy across varied soil types/depths; quantify tradeoffs.
- Reporting & demonstration: Deliver a prototype, datasets, analysis, and a short demo showing buried robot sending data to a surface receiver.

Research questions / Hypotheses

Can a soft worm locomote effectively in representative soil/phantom while housing RF electronics and an antenna?

Which RF band and antenna topology achieve the best soil-to-surface communication for the given robot size?

How does robot posture and surrounding soil permittivity affect antenna performance, and can antenna placement be optimized to maintain communication without sacrificing mobility?