

Electromagnetic Vibration Energy Harvesters for WSNs Apps

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ABSTRACT: The number of wireless sensor nodes deployed has increased exponentially due to the rapid development of wireless sensor networks over the past two decades. Making the sensing nodes self-powered can significantly increase the lifetime of the entire wireless sensing network and reduce the maintenance costs. Compared with other renewable energy sources, vibration energy is more prevalent and independent of the external environment, so it can effectively power wireless sensor nodes. Two types of electromagnetic vibration energy harvesters(EVEH) have been designed and demonstrated for the condition monitoring of power equipment and position tracking of vehicles.

A 50Hz EVEH for machine condition monitoring

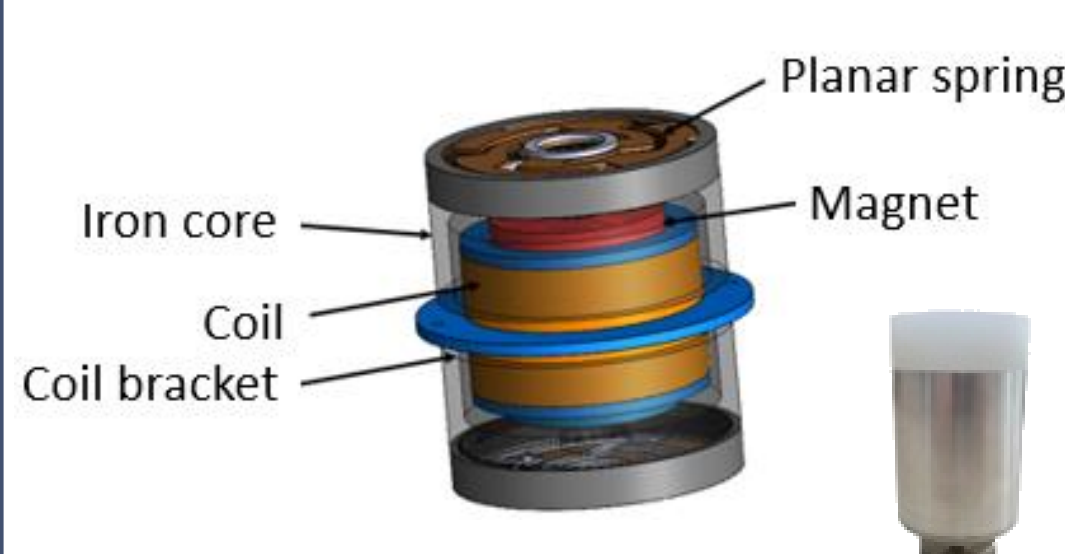


Fig. 1 Structure of 50Hz EVEH.

50 Hz EVEH Features:

- Having a closed iron core to enhance magnetic field.
- Using a pair of planar springs for single degree-of-freedom movement.
- High energy density($7.89\text{mWcm}^{-3}\text{g}^{-2}$).

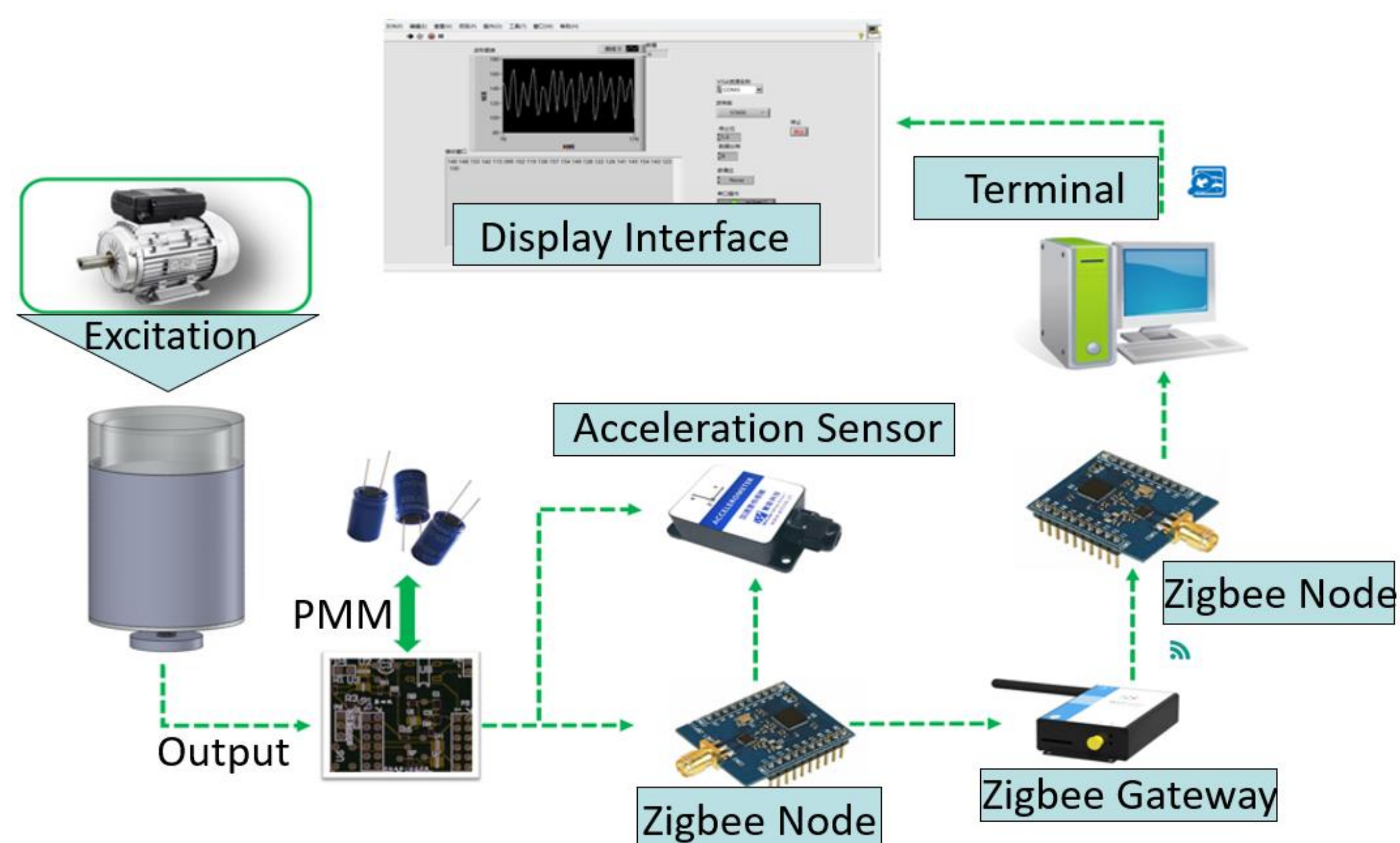


Fig. 2 Self-powered acceleration detection system based on 50Hz EVEH.

System consists of:

- EVEH Harvester
- Power Management Module
- μ -controller + Zigbee RF Module
- Acceleration Sensor
- User Interface on PC

Demonstrated performance
Designed for good power density and manufacturability

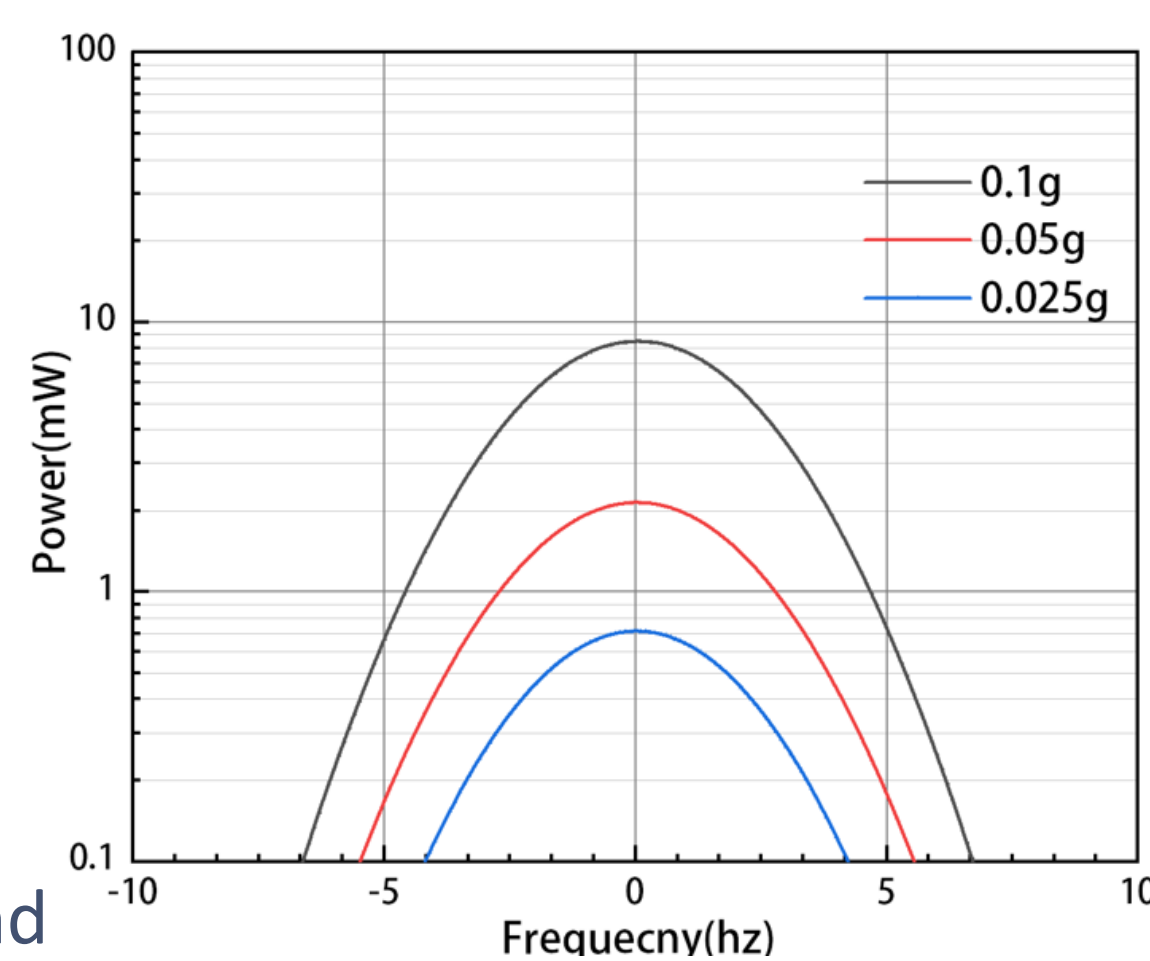


Fig. 3 Performance of 50Hz EVEH.

A 19.5Hz EVEH for vehicle positioning and tracking

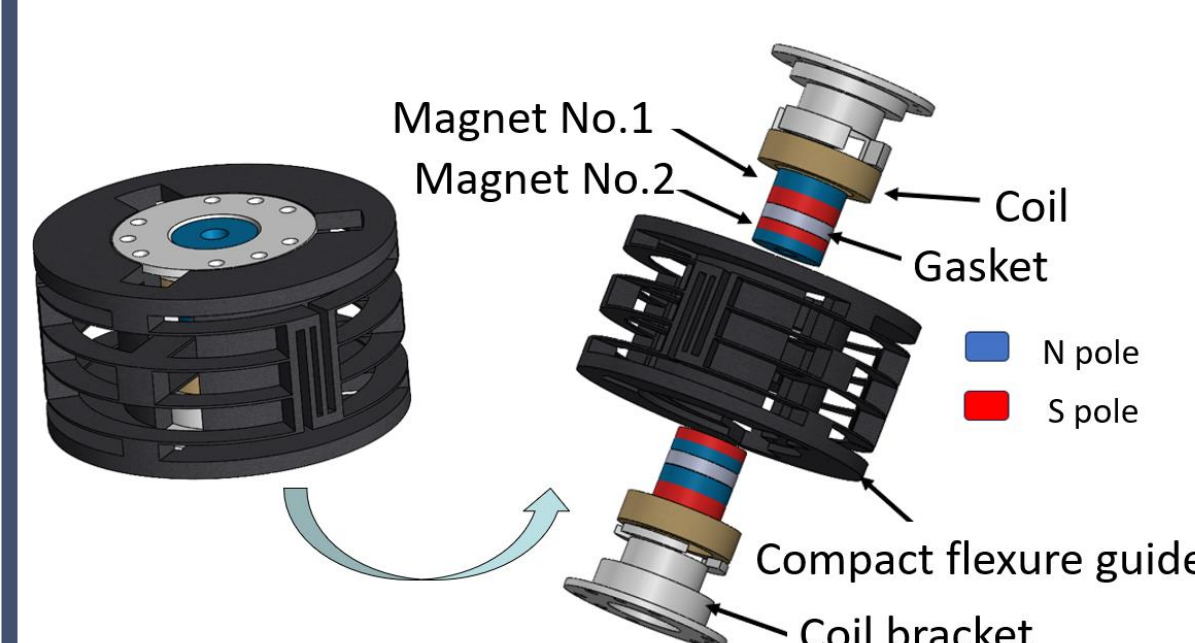


Fig. 4 Structure of 19.5Hz EVEH.

19.5 Hz EVEH Features:

- Compact flexure guide for single degree-of-freedom movement.
- High energy density ($3.28\text{mWcm}^{-3}\text{g}^{-2}$).
- Lightweight.
- Easy to assemble.

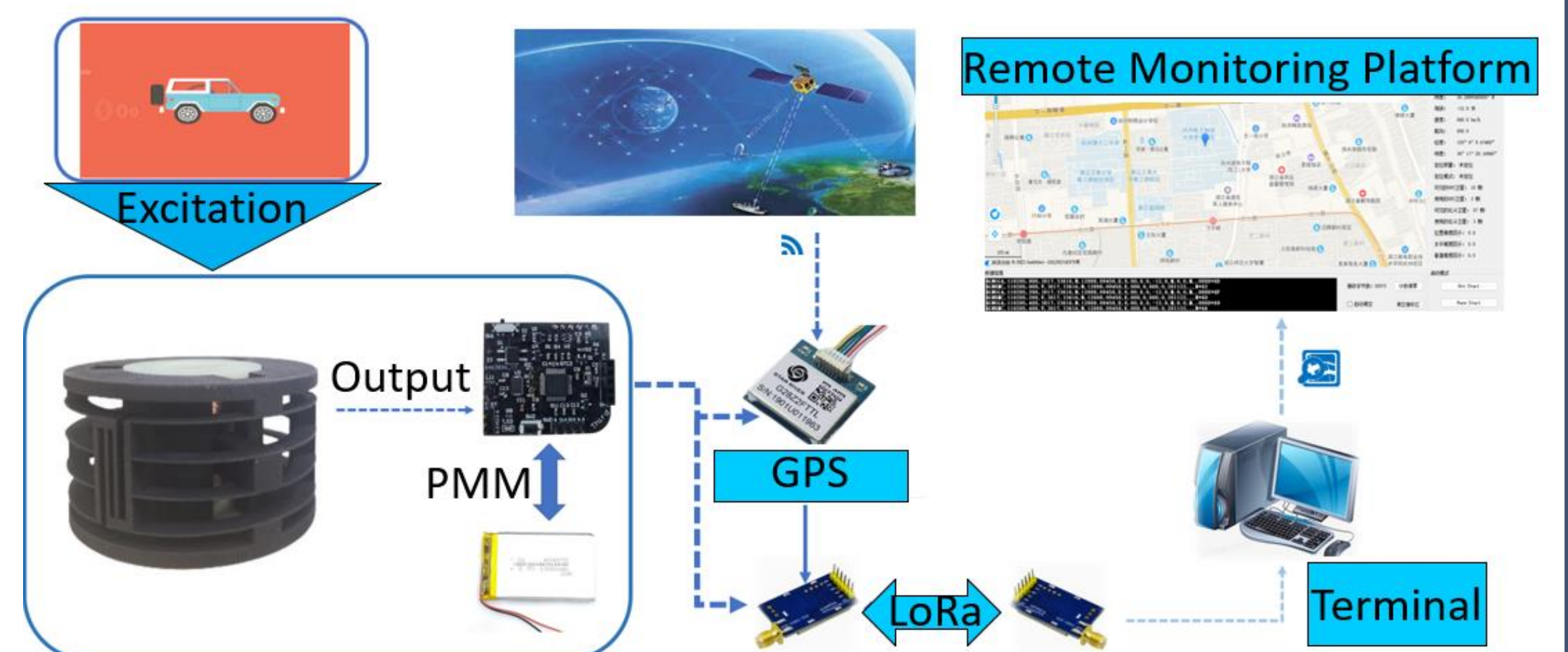


Fig. 5 Self-powered vehicle positioning & tracking system based on 19.5Hz EVEH.

System consists of:

- EVEH Harvester
- GPS Module
- μ -controller + LoRa Transmitter/Receiver
- Power Management Module
- User Interface/Map on PC

Demonstrated in a real vehicle
Easy to implement

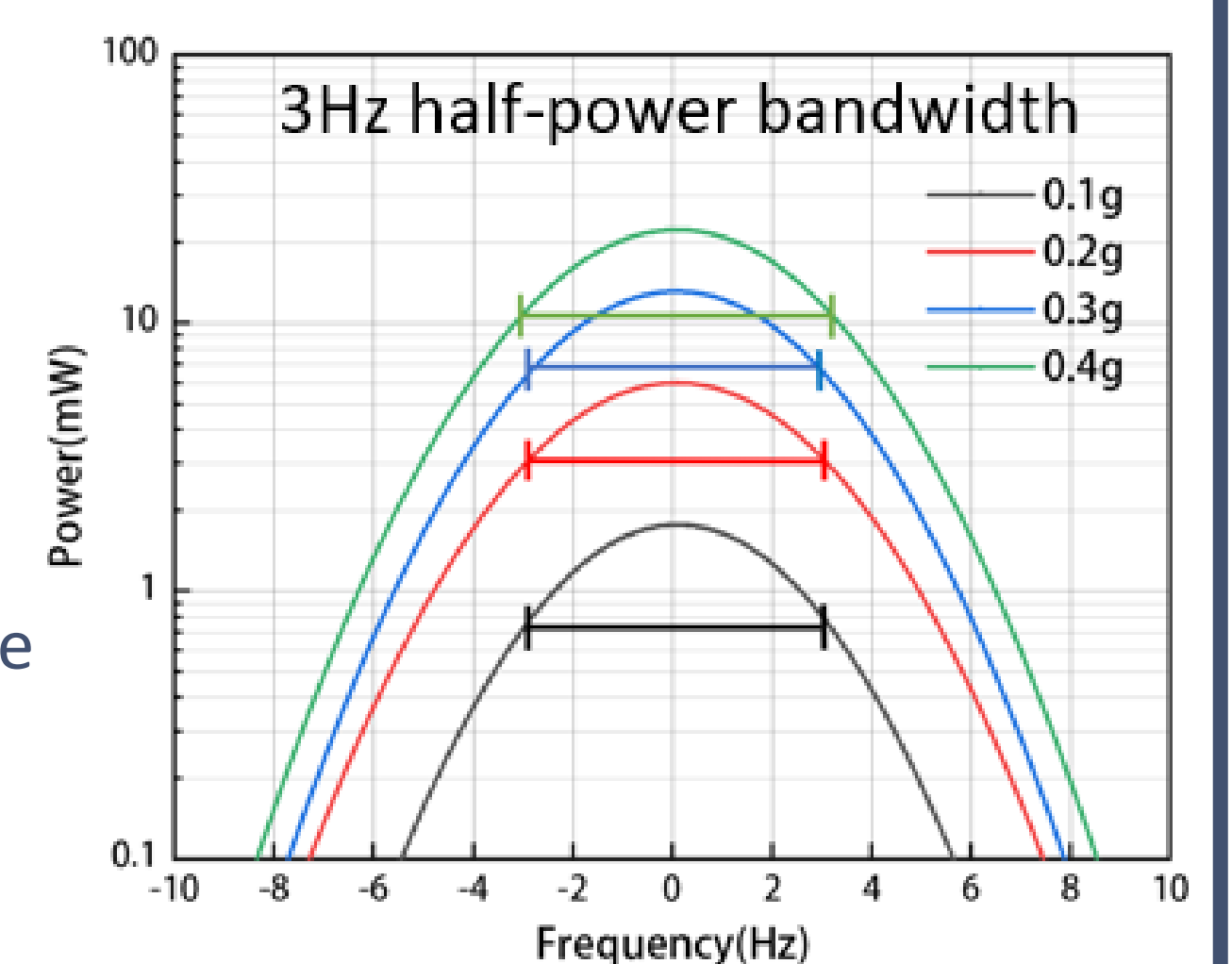


Fig. 6 Performance of 19.5Hz EVEH.

Summary

- Energy harvesting provides eco-friendly and maintenance-free long life solution for wireless sensing applications.
- A 50Hz EVEH has been successfully deployed in self-powered machine condition monitoring applications.
- A 19.5Hz EVEH has been demonstrated in a vehicle positioning and tracking system.
- Both harvesters and associated technology are suited for large scale deployment and commercialization.

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