Novel Passive Wireless Sensor System 
Utilizes Piezoelectric MEMS Resonator

UCF researchers have invented a passive wireless sensor system that includes a piezoelectric microelectromechanical systems (MEMS) resonator that can be configured to sense one or more physical parameters such as temperature, pressure, viscosity, and mass. This system is complementary metal oxide semiconductor-based, which utilizes silicon substrates and fab line processing techniques, and is thus significantly less expensive than other MEMS sensors. Additionally, this invention is smaller, typically less than a few square micrometers, and can potentially be used as medical implants. Compared to LC tank technology, this system provides measurements with higher resolutions and can be utilized at higher resolution and operating ranges. Due to their small size, these sensors do not waste any of the received energy to power up electronic circuitries.

Advantages
Most commercial sensors need batteries to operate which, in turn, limits their life spans. This device is wireless, requires no regular maintenance, and has no required minimum power for operation. Because of these features, the sensors can be placed on moving parts located inside an engine and also inside rotating objects such as tires. Along with its antenna, this sensor system can be configured to operate at most common desired frequencies based on the application. Furthermore, several separate sensors with multiple frequencies and independent measurements can be assembled onto one substrate.

Technical Details
This invention includes a base unit (or a transceiver) and a lateral-extensional MEMS resonator (sensing element) connected directly to an antenna with no additional components or power source. The base unit wirelessly transmits an RF signal to the sensor and analyzes the received signal. It harvests energy from the received RF signal to operate and then transmits the data back to the base unit within a few microseconds.

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Benefits
• Energy efficient
• Low cost
• Versatile
• Smaller size

Applications
• Rotating jet engines
• Automobile tire pressure
• Medical implants and sensors
• Food temperature

Tech Fields
Sensors

Keywords
piezoelectric, MEMS resonator, passive wireless sensors, RFID, LC tank, SAW sensors, surface acoustic wave sensors

Patent Pending
(a) The schematic of a 5th-order TPoS resonator and (b) the stress profile of a silicon slab with two pairs of fixed tethers at the 5th-order width-extensional mode.