National Aeronautics and Space Administration

Low-Profile, Multi-Measurement Wireless Sensor

A wireless inductance-capacitance sensor used to simultaneously measure multiple measurands

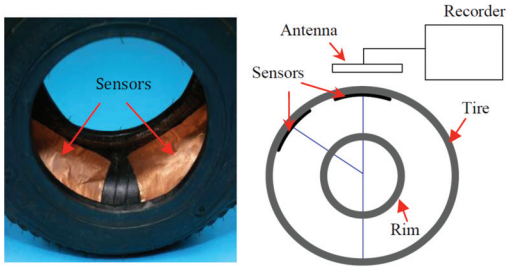
TECHNOLOGY OPPORTUNITY

NASA Langley researchers have developed a wireless low-profile sensor that uses a magnetic field response measurement acquisition system to provide power to the sensor and to acquire physical property measurements. SansEC (sans electrical connections) is a brand new system for sensing various physical quantities. It is a unique framework for designing, powering, interrogating, and manufacturing passive electrical sensors using only a single electrical component.

Unique to this sensor is the shape of the electrical traces that eliminates the need for separate inductance, capacitance, and connection circuitry. This feature gives the sensor a smaller circuit footprint to enable a smaller, flexible, and easy to fabricate sensor package. The shape of the electrical trace can be readily modified to sense different physical properties.

BENEFITS

- Receives power wirelessly, eliminating the need for a sensor power source
- Sends signals wirelessly to the data acquisition device, eliminating signal wiring
- Reduces system weight due to less wiring
- Reduces the number of electrical connections within the circuit, improving reliability
- Eliminates risk of electrical arcing in explosive conditions
- Easily modified to provide different response characteristics for sensing different physical properties simultaneously
- Inductive coupling of adjacent sensors requires only one sensor to be powered to obtain a full response from all sensors
- Enables use under corrosive, radioactive, extreme temperature, and other hazardous conditions
- Enables measurements in areas previously impractical to reach due to wiring constraints

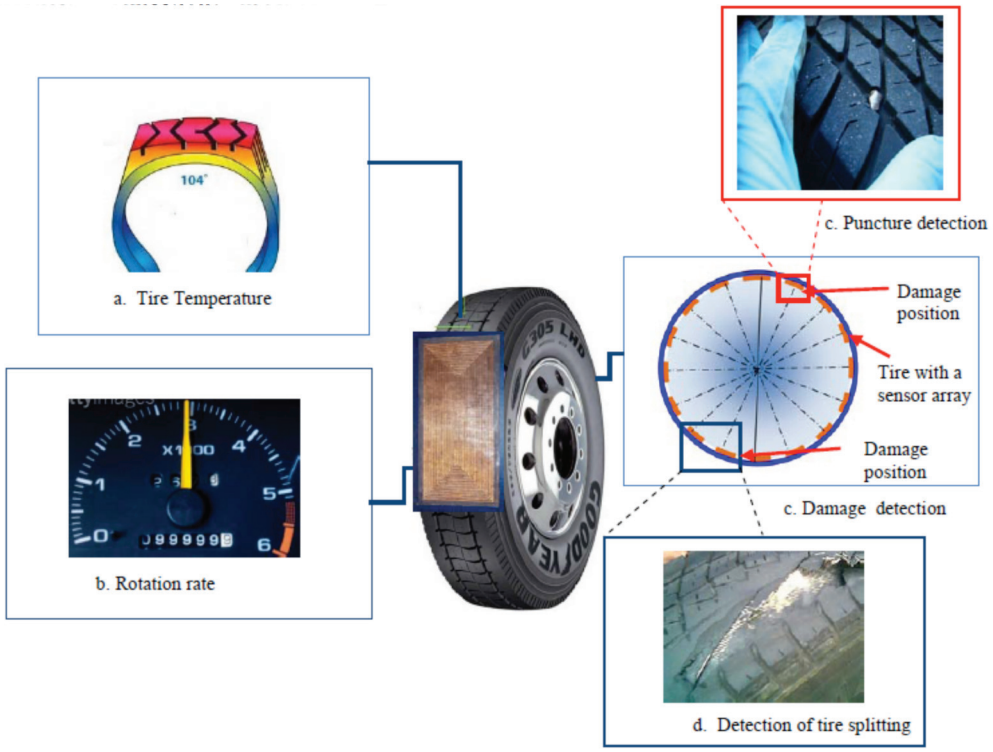


Sensor configuration and setup for sensing multiple un-related tire parameters

COMMERCIAL APPLICATIONS

The technology offers wide-ranging sensing for commercial applications, including:

- Automotive, motor sports, and trucking – tire pressure, tread wear, wheel speed, fuel level, and engine temperature
- Aerospace – landing gear health, fuselage integrity
- Industrial – foundry kiln temperature, cryogenic liquid level, materials cure process



Multiple unrelated tire parameter measured by the SansEC temperature sensor. One sensor can concurrently measure tire temperature, tire damage, and rotational rate. A sensor array can detect tire damage and damage position.

TECHNOLOGY DESCRIPTION

The low-profile sensor is configured with a spiral electrical trace on flexible substrate. In typical inductor designs, the space between traces is designed to minimize parasitic conductance to reduce the impact of the capacitance to neighboring electronics. In this low-profile sensor, however, greater capacitance is desired to allow the operation of an inductor-capacitor circuit. This allows the traces to be closer together, decreasing the overall size of the spiral trace.

The sensor receives a signal from the accompanying magnetic field data acquisition system. Once electrically active, the sensor produces its own harmonic magnetic field as the inductor stores and releases magnetic energy. The antenna of the measurement acquisition system is switched from a transmitting to a receiving mode to acquire the magnetic-field response of the sensor. The magnetic-field response attributes of frequency, amplitude, and bandwidth of the inductor correspond to the physical property states measured by the sensor. The received response is correlated to calibration data to determine the physical property measurement. When multiple sensors are inductively coupled, the data acquisition system needs to activate and read only one sensor to obtain measurement data from all of them. Various physical quantities can be measured such as: temperature, pressure, strain, structural damage, rotational velocity, and much more.

PATENTS

The low-profile sensor technology includes U.S. patent application 20070181683.

FOR MORE INFORMATION

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

National Aeronautics and Space Administration
Langley Research Center
Mail Stop 218
Hampton, VA 23681
757.864.1178
LARC-DL-technologygateway@mail.nasa.gov
technologygateway.nasa.gov
www.nasa.gov

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