National Aeronautics and Space Administration

technology opportunity

Extended Range RFID and Sensor Tag

An energy-efficient method for increasing the range of SAW RF tags for passive RFID and sensor systems





NASA's Johnson Space Center has developed a novel technology that enhances the performance of surface acoustic wave radio frequency (SAW RF) tags for passive radio frequency identification (RFID) and sensor applications. This innovation significantly extends operational range without necessitating additional transmit power. Conversely, it can reduce transmit power requirements for shorter range passive RFID systems. The inherent temperature- and pressure-sensitive qualities of the SAW RF components also render this device ideal for remote sensing applications.

Benefits

- **Extended range:** Provides an effective means of scaling the operational distance of RFID and passive wireless sensor capabilities
- **Improved accuracy:** Offers enhanced range estimates and bearing angle (angle of arrival) measurements for real-time location systems
- **High efficiency:** Delivers either greater range without a corresponding increase in required power or allows for substantially lower transmit power while operating in typical passive RFID ranges
- **Inherently rugged:** Operates effectively in challenging conditions and at extreme temperatures

Applications

- Real-time location systems for first responder personnel and assets
- Hospital patient tracking
- Vehicle and container tracking in harsh conditions
- Remote temperature and pressure tracking for applications such as food processing and distribution

The Technology

Passive RFID tags offer a popular option for RFID tracking applications. Lightweight and requiring no battery, these devices are inexpensive to the point of being disposable. Seeking to develop robust tracking and positioning systems for use on the lunar or planetary surfaces, as well as for space vehicle proximity operations, JSC researchers developed a simple yet effective method for overcoming a characteristic disadvantage of the technology: limited range.

How It Works

This scalable technology uses a pair of phase-matched SAW RF tags coupled with a Van Atta antenna array. Typically composed of piezoelectric lithium niobate or quartz, SAW RF tags convert the interrogating signal into a surface acoustic wave, which is then encoded with the tag's unique identification number as the wave encounters a series of reflectors etched in the crystal. With the ID added, the modulated signal then converts back to electromagnetic energy and is transmitted back to the interrogator. The influence of temperature and pressure on the reflected signal can also be measured, making the devices useful as remote sensors.

The Van Atta antenna component receives the interrogating signal and then, once the signal has been imprinted with the code from the SAW RF tags, reflects it in the direction of its arrival. The result is passive beam-steering and tracking of the interrogator without prior knowledge of its location. The increased gain provided by the array allows for extended range or for reduced transmit power from the interrogator within shorter distances.

Why It Is Better

In its simplest form, a basic two-element building block, this technology's innovative SAW-Van Atta array combination provides a 37% increase in free space range over existing passive RFID technologies—without need for additional power. To achieve the same range increase without this innovation, a 250% boost in transmit power would be required. The simplicity of the technology's design allows users to achieve this enhanced performance using commercially available SAW crystals—no modifications required—and the array is scalable to include additional coupled elements to further increase the directionality and thus range of the system.

The natural ruggedness of the SAW RF components also provides an advantage over silicon RFID tags. SAW RF tags have an operational temperature range of at least -230°C to 315°C and are highly resistant to radiation-induced failure. The tags' inherent temperature and pressure dependence allows the devices to track environmental information in addition to their RFID tracking capabilities.

Patents

Johnson Space Center has filed for patent protection for this technology.

Licensing and Partnering Opportunities

This technology is being made available as part of NASA's Innovative Partnerships Program (IPP), which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Extended Range RFID and Sensor Tag technology (MSC-24346-1) for commercial applications.

For More Information

If you would like more information about this technology, please contact:

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For more information about other technology licensing opportunities, please visit:

Advanced Planning Office
NASA's Johnson Space Center
http://technology.jsc.nasa.gov

Fuentek is a contractor to NASA's Innovative Partnerships Program, providing support for the access and transfer of technology.