Call for Presentations

2020 Passive Wireless Sensor Technology Workshop

Hosted by WiSEE 2020, Vicenza, Italy – October 12-14, 2020

(https://attend.ieee.org/wisee-2020/program/workshops/)

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Contact PWST CoChairs ASAP to get one of the limited presentation slots for next October!

PWST Workshop Sessions (preliminary):

- **Only 18 presentation slots available for User Needs and Applications**
- **Only 28 presentation slots available for Technologies and Capabilities**

Technology Presentations (28 max)	User Presentations (18max)
SAW & BAW	Smart City and Smart Agriculture and IOT
WAIC Systems(4.2-4.4GHz)	Commercial Aircraft
Long Range PWS	Lunar Surface Sensing
Standards/International Regulations	Drone augmentation
Optical and Imaging Based PWS	Spacecraft Systems
3-D Printed/Additive Manufacturing	Launch Vehicles
Through-Wall	Transportation and Infrastructure
Remote and Scavenge Power	Help for Disadvantaged Peoples/Countries
"Off-the-Shelf" PWS	Cell phone, 5G and other consumer electronics
"Off-the-Wall" PWS	Local Italian Interests and Research
Hybrid Active-Passive	Oil and Gas/Energy
Extreme Temperature	Propulsion and Power Systems

Schedule:

- **June 1: Preliminary PWST Workshop Speaker List (w/Titles)**
- **July 1: 1 page Speaker Summaries (Presenter Title/Photo/Bio/Abstracts)**
- **October 1: Presentations Due – Cleared for Public Release by the workshop**
- **October 12-14: PWST Workshop at WiSEE 2020, Vicenza**

Other PWST Workshop Content:

- **Demonstrations and Displays/Posters**
- **One-on-One Sessions with Potential Users**
- **Discussion Panels: *tbd***

Passive Wireless Sensor Technology Workshop

Purpose: To bring Passive Wireless Sensor (PWS) technology developers, manufacturers and potential industry end-users together to understand the larger market drivers that will drive costs down and applications up. At WiSEE, of course we will concentrate on Aerospace and Extreme Environment Applications, but other industries that can benefit from similar technologies are encouraged to participate! The entire this PWS Workshop library of past presentations, programs and other information is available at:

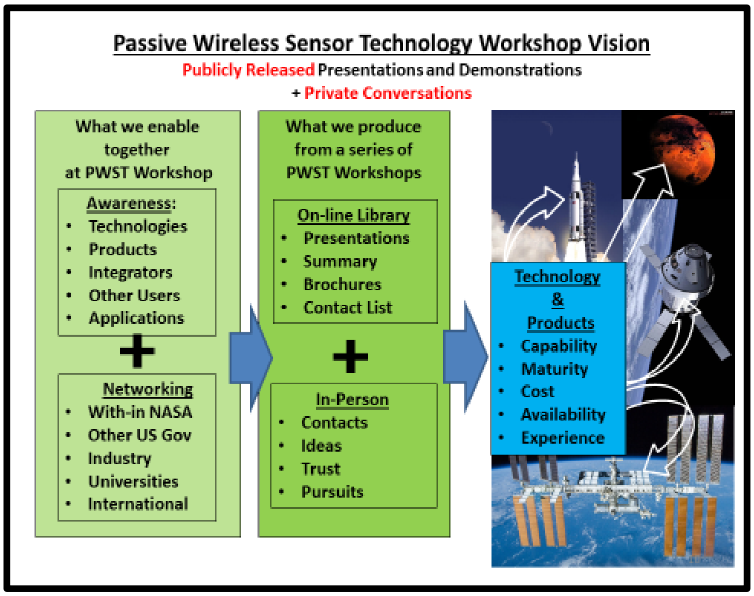
https://emw-meza.site/pwst/index.php/Files/Workshop_Presentations

Objectives:

1. Understand various PWS technologies, actual & potential uses, and maturity.
2. Share applications, benefits & limitations of PWS between industries and agencies.
3. Precipitate individual & group "next step" thinking to further develop/apply PWS.
4. Continue building an accessible library of PWS Workshop publicly released presentations.

Why Passive Wireless Sensors?

- NO Wire to the sensor
- NO Battery
- NO Complex Electronics
- Low Production cost
- Low Operations cost
- Low Safety concern
- High Modularity
- Extreme Environments
- Wide Application potential



Technology examples:

- Passive RFID sensing
- Higher freq. wireless SAW/BAW sensors (4.2-4.4GHz)
- Passive Optical Wireless sensing
- Dielectric Resonators
- Through wall (penetrating) and underwater/liquid sensing
- Software defined radios and optimized antennas
- Manufacturing methods for high rate/low cost – 3D Printing
- Location/proximity navigation using passive wireless sensors
- Hybrid Active Wireless Nodes and Passive Wireless Sensors

Application Examples:

- Spacecraft wire harness & redundancy
- Commercial Aircraft On-board wireless
- Industrial/Building monitors, Secure RF
- Miniature form-factor apps, Ext Enviro.
- High temperature, chemical, biological
- Aerospace vehicles, Manufacture, Test
- High freq. SAW, embedded PWS
- Manufacturing, mapping, operations
- Industrial Wireless: No wire to sensors

Passive Wireless Sensor Technology (PWST): Technology and Applications

Reducing wires, connectors and penetrations has the benefits in every aspect of aerospace and other industry objectives from cost and schedule to capability and performance. Radio Frequency communications between active sensor nodes has been maturing, but now other technologies are emerging that can eliminate the need for electronics/power source at the wireless sensor, eliminate the wire between the sensor and the data acquisition system, eliminate the need for data and some power connectors between avionics, and reduce the need for penetrations and access across bulkheads. Some of the passive wireless technologies have been demonstrated at 1200º C and others at cryogenic hydrogen temperatures. The cost is a huge factor for industry, both initially and for life-time operations, and yet in most industries, the cost per measurement and cost of connectivity is looked at from a wired point of view, that is mainly installation and other direct impacts. By providing options that eliminate wires, connectors and penetrations the PWST workshops provide a new set of options for both the vehicle, facility and environment monitoring and communication systems engineer. By getting users and stakeholders to discuss their needs, everyone gets to understand the overall potential demand for the technology as well as who might make good partners for research, development and application. The SAW devices are very cheaply produced in large volumes already and advent of 3D printed electronics provides the potential for very low cost passive wireless sensors for SAW and other passive wireless modes as well.

The case for using scavenge power, from physical energy or broadcasted, to charge batteries and capacitors for wireless standalone devices is strong because it can enable longer life for sensing in more benign environments. However the cost for each data point, its infrastructure and physical restrictions on application remain (e.g. temperature, safety, etc.) make many applications scavenge power methods impractical. There are cases though where the radiated power can augment interrogation of the passive sensor and provide higher performance from the sensor without the need for a battery. As a guide for our workshops, think of passive wireless as requiring no battery, no expensive electronics at the sensor site and (of course) no need for a wired connection between the sensor and the data acquisition system. Passive Wireless Sensors could be useful at short or long range, mobile platforms or fixed, simply printed for shirt-sleeve environment or sophisticated for high performance and extreme environments. Surface Acoustic Wave (SAW)-based sensors, in a manner somewhat similar to a classic passive RFID tag, responds to a wireless interrogation signal from a reader, but unlike RFID it provides real-time sensor data along with its unique tag id, stored information and range. As time goes on, more interrogation methods are being discovered while the others are being matured. PWSTs should aspire to be manufactured in high volume – even incorporating direct write fabrication - resulting in an inexpensive devices. With its considerable potential read-range (separation distance between reader and device), compatibility with extreme environments, small size, autonomy of sensor installation, and "no onboard power" capabilities, PWSs have a wider application arena than current battery-powered wireless sensors. Enabling technologies such as new manufacturing, materials, antennas and interrogators are encouraged to be brought forward.

The PWST workshop will explore these and other motivations for using PWSTs in a variety of fields, present and demonstrate current technologies, explore current and future applications of PWSTs in various industries. A key component of this two-day PWST Workshop is to facilitate discussions between end users and developers/suppliers on application areas of mutual interest.

Examples of Passive Wireless Communication/Sensing

- Surface Acoustic Wave-based
- Bulk Acoustic Wave-based
- RLC-based
- RFID-based
- Dielectric Resonators-based
- NFC-based
- Optical-based
- 60 GHz – based
- IR-based
- RF Antenna-based or Antenna only
- Backscatter-RF based
- Multi-spectral response materials and sensors
- Remote-powered Micro/Nano-sensor systems
- Various MEMS
- Through-Wall Communications & Power:
  - Magnetic Field, Acoustic Emissions
  - Ultrasonic, X-Ray Comm
- 3D Printed/Advanced Manufacturing, Flex

Passive Surface Acoustic Wave(SAW) & Bulk Acoustic Wave(BAW) Wireless Technologies

- Surface Acoustic Waves and Bulk Acoustic Wave based
- Sensor Performance: data rates, range, multi-sensors, reduced configuration dependencies
- Manufacturing: cost, quality, reliability, configurability, techniques(e.g. 3D) sensor & ant
- Interrogators: cost, size, weight, interrogation rates/# of sensors, antennas, ruggedness
- Maturity/Availability: proven applications, COTS availability, technology readiness level
- Security - https://www.isa.org/intech/20171201/

Applications for Aerospace:

- Otherwise Impractical Measurements:

- Rotating Parts – blades + mechanisms, hot turbines
- Difficult Access: vehicle zones, avionics, tanks/reservoirs, chambers, balloon, parachutes
- Remote interrogation – off-board (grnd-vehicle) and on-board (exterior/interior sensing)
- Interrogation through structures and liquids – avoid penetrations, wiring
- Extreme environments – hot turbines, re-entry protection, cold high altitude/space/winter conditions, vacuum, high radiation, shock/vibration/pressure

- Capability and Performance:

- Light weight/small size – vehicle payload capacity, efficiency, system monitoring
- Multi-path RF, other interferences/configuration dependencies, safety, directional sensing
- Low integration cost/schedule: deferred instrumentation decisions, integrated vehicle test changes, flt/ground test temporary Instr, aging vehicle ops, condition-based monitoring
- Convert Wired Sensors to Passive Wireless – chemical, biological, physical
- Manufacturing/Asset data/location – embedded updatable tags, in-place direct-write tags,
- RF compatibility with Spectrum authorized use and developing Standards
- Use of Optical, X-ray and other low/high frequencies, Magnetic field, Electrical Charge, Ultrasonic for free-space and conducted transmission