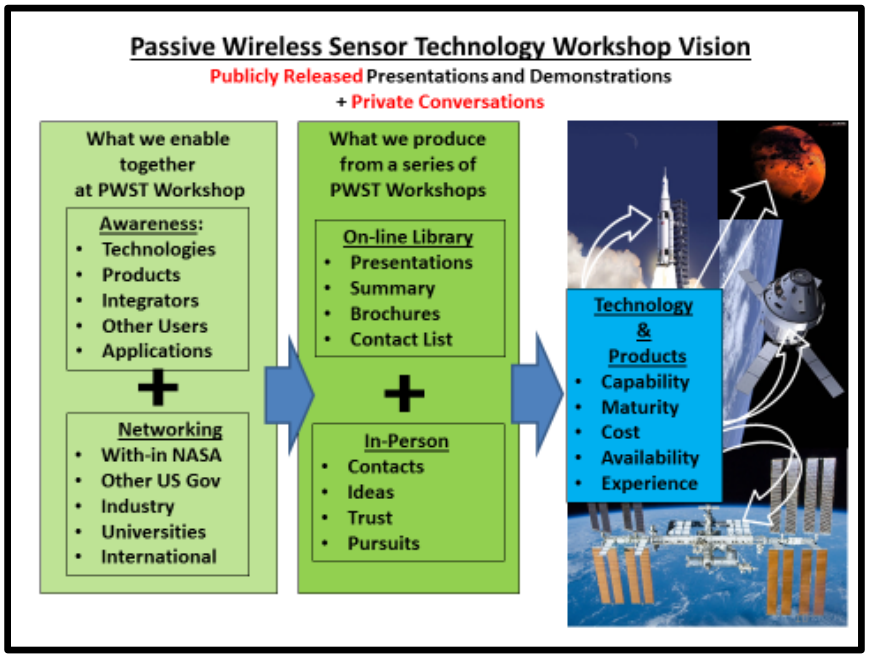
Passive Wireless Sensor Technology Workshop
WiSEE 2015, Orlando, FL
Dec 14-16, 2015

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. We will concentrate on Aerospace applications at this workshop, so capability that helps the aerospace manufacturing, mission and maintenance will be a priority.

Objectives:

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



Past Public Presentations and Summaries:

PWST 2011, 2012, 2013
http://archive.isa.org/MSTemplate.cfm?Section=Passive_Wireless_Sensor_Workshop&Site=Computer_Tech__Division&Template=/ContentManagement/MSContentDisplay.cfm&ContentID=92282

PWST 2015: http://futureinstruments.ornl.gov/pdfs/FIIW-2015-Agenda-Website-Agenda.pdf

Chairman: **George Studor**
NASA Engineering & Safety Center
Avionics Technical Discipline Team
Wireless Avionics Community of Practice
George.F.Studor@NASA.Gov
281-415-3986(cell)

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 1200 Degrees 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
- NFC-based
- Optical Comm-based
- 60 GHz – based
- RF Antenna-based or Antenna only

Through-Wall Comm & Power:

- Magnetic Field
- Acoustic Emissions
- Ultrasonic
- X-Ray Comm

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

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, XRay and other low/high frequencies, Magnetic field, Electrical Charge, Ultrasonic for free-space and conducted transmission

Applications for Other Industries and Government Agencies

- DOE – Buildings, Grid, Nuclear
- DOT – Roads, Bridges/tracks, Vehicles
- DOD – Vehicles, Weapons, Soldiers, Logistics, Environments, many others
- DHS – Discrete Sensing & Locating
- USDA - Forest Service, Agriculture, Food
- DNR – Wildlife, Soils, Agriculture, Water, etc
- DoC - NOAA – Weather, Quakes, Fires, etc
- DHHS – Health and Medical

Passive Wireless Sensor Technology Workshop Program
Tuesday Dec 15 - Room B
Wednesday Dec 16 – Rooms A, B and C

Tuesday Dec 15			
8:00-9:45 AM Plenary Speakers			
08:15-08:30	Announcements	Bob Youngquist	NASA/KSC
08:30-09:15	NASA Wireless Mission Support Concepts	Steve Horan	NASA/LaRC
09:15-10:00M	Disruption Tolerant Networking: An Architecture for Challenged Communications	Jason Soloff	NASA/JSC
	- DTN deployment kit demonstration during the break	Adam Schlesinger	NASA/JSC
10:00-10:30 AM Break			
10:30-12:00 PWS-S1			
10:30-11:00	Passive Wireless Sensor Technologies & Needs - a Library of Info	George Studor	NASA/NESC
	and Overview of SAW technology (UCF) and Demonstration	Arthur Weeks	UCF
11:00-11:30	On low cost ubiquitous sensor networks: DOE needs and application areas	Tim McIntyre	DOE/ORNL
11:30-12:00	Inflatable Reentry Vehicles and Instrumentation Needs	Robert Dillman	NASA/LaRC
12:00-1:30PM	**Networking Lunch in the Patio**		
1:30-3:00 PWS-S2			
1:30-2:00	Aircraft Wireless Tire Pressure Sensing and Harsh Environmental Constraints	Bill Andrew	Airbus
2:00-2:30	Wireless Avionics Intra-Aircraft Communications(WAIC) for Commercial Aircraft	Dave Redman	AVSI
2:30-3:00	Partnership Opportunities with AFRC for Wireless Systems Flight Testing	Richard Hang	NASA/AFRC
3:00-3:30 PM Break			
3:30-4:20 Plenary Speakers			
3:30-4:00	NASA Aeronautics Strategic Direction and Aeronautical Research Programs	Jay Dryer	NASA/ARMD
4:00-4:20	NASA Experimental Program to Stimulate Competitive Research (EPSCoR)	Jeppie Compton	NASA/KSC
4:20-5:00	User Government-Industry Panel - Q & A - All WiSEE is invited A set of questions will be prepared ahead of time plus from the audience real-time	George Studor Moderator	
5:10-6:00 PM	**One-on-One Sessions with User/Stakeholders - all WiSEE is Invited** Developers Sign-up at registration desk to meet privately with User/Stakeholders	10min time slots	
Wednesday Dec 16			
08:00-09:30 AM Plenary Speakers			
08:00-08:45	Optical Wireless, Theory and Applications	Mohsen Kavehrad	Penn State U
08:45-09:30	NASA and LVX System Partnership for Development of Light Comm Technologies	Jack Fox	NASA/KSC
09:30-10:00 AM Break			
10:00-12:00 PWS-3A: Wireless Through-wall Comm & Power – Room A			
10:00-10:30	Cryogenic Applications for Wireless Power and Data using Magnetics	Garrick Merrill	NASA/MSFC
10:30-11:00	Ultrasonic Communication for High-Data Rate Through-Metal Applications	Cem Sahin	Drexel
11:00-11:30	Acoustic Data and Power Transmission through and Along Solid Structures	Kyle Wilt	RPI
11:30-12:00	Robust UWB Communication in Large Ship Interiors	Farid Dowla	LLNL
10:00-12:00 PWS-3B: Passive Wireless SAW and RFID Sensors – Room B			
10:00-10:30	A Spacecraft Backbone - Plug 'n' Play Concepts for a Deep Space Habitat	Kimberly Simpson	NASA/JPL
10:30-11:00	Software Defined Radio Approach for Passive, Wireless RFID Sensors	James"Trip" Humphries	UCF
11:00-11:30	Passive RFID Sensing for Harsh Environments - LLNL-Dirac Platform	Faranak Nekoogar	LLNL
11:30-12:00	Improving Performance of Passive RFID-based Part-DNA for Rotor-head Maintenance Application	Maciej Zawodniok	Missouri S&T
10:00-12:00 PWS-3C: NASA Potential Users for Wireless – Room C			
10:00-10:30	The NASA Sounding Rocket Program and Technology Needs	Brian Hall	NASA/WFF
10:30-11:00	Aerojet Rocketdyne Propulsion System PWST Needs/Challenges	James Larkin	Aerojet Rocketdyne
11:00-11:30	4 High Value Wireless Applications at Marshall Spaceflight Center with their Challenges	Leo Fabinski	NASA/MSFC
11:30-12:00	Instrumentation Overview of Space Environment Test Facilities at Plumbrook	Rich Evans	NASA/Plumbrook
12:00-12:15 PM Best Paper Award and Closing Ceremony			
12:15 - 1:00PM	**Pick me-up lunch**		
12:30 - 3:00PM	**One-on-One Sessions with User/Stakeholders- all WiSEE is Invited** Developers Sign-up at registration desk to meet privately with User/Stakeholders	15 minute time slots	

Monday, Dec 14th, Banquet Speaker

"Wireless Challenges and UCF Solutions"

Don Malocha — **Professor, EE and Director, CAAT**
donald.malocha@ucf.edu — **Consortium for Applied Acousto-electronic Technology**
407-823-2414 — **University of Central Florida, Orlando**
http://caat.engr.ucf.edu/

Background:

Donald (Don) Malocha is a Pegasus Professor in the Electrical and Computer Engineering Department at the University of Central Florida. He also serves as Director for the UCF-based, Consortium for Applied Acousto-electronic Technology (CAAT). His current research interests include solid–state devices, surface acoustic wave (SAW) and bulk acoustic wave (BAW) technology, sensors and wireless radio frequency systems. He is advisor for 37-MS and 19-PhD students. Don Malocha earned his B.S. degree in electrical engineering/computer science, and his M.S. and Ph.D. degrees in electrical engineering from the University of Illinois at Urbana-Champaign, Urbana, IL, in 1972, 1974, and 1977, respectively. Don has been with UCF since 1982 and is an IEEE Fellow. He has been a visiting scholar at the Swiss Federal Institute Technology, Zurich, and the University of Linz, Austria. In industry, Don was a member of the Corporate Research Laboratories at Texas Instruments in Dallas; Manager of Advanced Product Development at Sawtek, Orlando; and a visiting Member of the Technical Staff, Motorola, Phoenix, AZ and Fort Lauderdale.

Tues, Dec 15th, Keynote-3, 8:30am

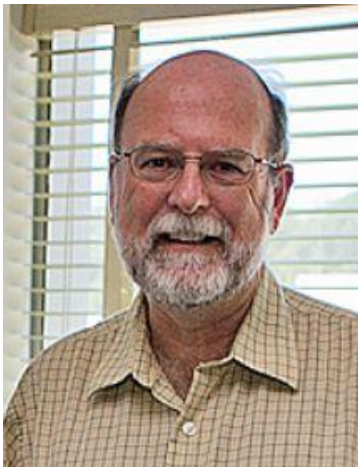
"NASA Wireless Mission Support Concepts"

Dr. Steve Horan **Principal Technologist, Game Changing Development Program**
steven.j.horan@nasa.gov **NASA Langley Research Center**
757-864-6986 **http://gcd.larc.nasa.gov/about**

Abstract:

In this presentation, we will examine mission challenges from the perspective of multiple NASA Centers. These are not the only Agency challenges but this is to give a flavor of the concepts being developed. We will also discuss the new SBIR opportunity for NASA Wireless development.

Background:



Steve Horan is Principal Technologist for NASA's Game Changing Development Program, with primary technical interest/focus on spacecraft avionic systems, communication systems, and technologies to advance the capabilities for small satellite systems. Dr. Horan joined NASA Langley Research Center in 2009 as the CLARREO spacecraft communications lead. He also worked on the communications architecture for the hosted payload concept used in the CHRONOS proposal for the Earth Venture solicitation. In January 2012, Dr. Horan became the Assistant Branch Head for the Remote Sensing Flight Systems Branch and from June 2012 through August 2013, he was Acting Branch Head. During this time, he supported the communications design in the avionics system for the HEART project. He also initiated the concept and the team for the Langley RaD-X Hands-On Project Experience proposal submission. Prior to joining NASA, Dr. Horan was on the faculty of New Mexico State University (NMSU) and left as Professor and Department Head of the Klipsch School of Electrical and Computer Engineering. At NMSU, he developed and taught classes in digital communications, satellite communications, and telemetry systems. He had numerous grants in space communications, radio propagation measurements, and microsatellite development funded by NASA and the Air Force. He was also the founding director of the New Mexico Space Grant Consortium. Dr. Horan participated in the NASA/ASEE Summer Faculty Fellowship program at Johnson Space Center and Goddard Space Flight Center. Dr. Horan has authored or co-authored 57 conference papers, 20 journal articles, 1 patent, and the textbook Introduction to PCM Telemetering Systems. He has taught short courses on telemetering systems, radio propagation, and digital modulation in conjunction with the International Telemetering Conference. He is a senior member of both the IEEE and the AIAA. Steve received a B.A. in Physics from Franklin and Marshall College (1976), an M.S. in Astronomy from New Mexico State University (1979), an M.S. in Electrical Engineering from New Mexico State University (1981) and his Ph.D. in EE from NMSU(1984).

Tues, Dec 15th, Keynote-4, 9:15am

"Disruption Tolerant Networking: An Architecture for Challenged Communications"

Jason Soloff — **Systems Engineering Lead**
jason.a.soloff@nasa.gov — **Human Exploration and Operations Mission Directorate**
281-483-3554 — **NASA Johnson Space Center**

Abstract:

Background:

Mr. Soloff serves NASA's Human Exploration and Operations Mission Directorate as the Lead for System Security Engineering, Delay/Disruption Tolerant Networking (DTN) Architect, and Space Object Array Radar (SOAR) Formulation Manager. In this capacity, Mr. Soloff is responsible for ensuring Human Space Flight systems employ system engineering rigor in order to identify, assess, manage and mitigate risks to successful mission operations. Mr. Soloff is also responsible for development, coordination and integration of communications and space networking, remote sensing, and space situational awareness technologies for NASA's human exploration program. Mr. Soloff serves as a Systems Engineering Lead for the NASA Human Exploration and Operations Mission Directorate. Mr. Soloff is a member of NASA's delegation to the Space Internetworking Architecture Group of the IOAG. Mr. Soloff's experience includes staff positions in the GSFC Microwave & Communication Systems Branch, the JSC Avionics Systems Division, and as the Lead of the Avionics & Communications Office for the Constellation Program. Mr. Soloff's other program experience includes the Global Precipitation Measurement Mission (GPM), the Lunar Reconnaissance Orbiter (LRO), Space Shuttle, and the International Space Station. Mr. Soloff holds undergraduate and master degrees from the Pennsylvania State University, and a Graduate Certificate in Space Systems Engineering from Stevens Institute of Technology.

Mr. Schlesinger is the technical lead for the Advanced Exploration Systems (AES) Delay/Disruption Tolerant Networking (DTN) Project and the deputy project manager for the AES Avionics and Software Project at NASA Johnson Space Center (JSC). Mr. Schlesinger has led efforts to infuse DTN technology on the International Space Station (ISS) and with other AES projects. Mr. Schlesinger also supports the Human Exploration and Operations Mission Directorate (HEOMD), in the areas of avionics, communications, networks and security, to develop architectures and technologies for future space exploration. Mr. Schlesinger holds a Bachelor's degree in Electrical Engineering from the University of Michigan and a Master's degree in Electrical and Computer Engineering from the Georgia Institute of Technology.

Tues, Dec 15th, PWS1-1a, 10:30am

"Passive Wireless Sensor Technologies & Needs - a Library of Information"

George Studor
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763-208-9283
281-415-3986

NASA Engineering and Safety Center
Avionics Technical Discipline Team, consultant
Lead, Wireless Avionics Community of Practice
Langley Research Center, VA

Abstract: The motivation and background for the Passive Wireless Sensor Technology Workshops (PWST) will be presented. The intent of these workshops is to provide information that fosters relationships that advance technologies which reduce wires, connectors and penetrations in aerospace vehicles. Both users, stakeholders and developers and capability providers are invited that bring something new to a library of needs and technologies in world of less wires, connectors and penetrations. An overview of what is planned for the two-day workshop at WiSEE 2015 will be covered next, including the method of signing up for and conducting the one-on-one sessions. In addition, a summary of past PWST Workshop presentations will be introduced that enables interested parties to quickly discover which publicly accessible presentations are of interest. The various types of Passive Wireless Sensor Technologies are a part of the tool-box of alternatives to standard wired connections – one of three important legs of the "Fly-by-Wireless" approach George has promoted for over 15 years. The other 2 elements are: the vehicle architectural provisions and management direction, skills and metrics.

Background:

Mr. George Studor retired from NASA in October 2013. Since then he has concurrently been a consultant to the NASA Engineering and Safety Center for three Technical Discipline Teams(TDTs): Avionics TDT - Wireless Avionics Connections, Non-Destructive Evaluation TDT – In-Space Inspection, and Robotic Spacecraft TDT – Application of Natural Systems to Systems Engineering process. George organized and chaired 4 previous Passive Wireless Workshops in 2011, 2012, 2013 and 2015 supported by the Avionics TDT, the Industrial Society for Automation and DOE, Oak Ridge National Labs. In addition, he has been consultant to the Image Science and Analysis Group at Johnson Space Center through Jacobs Engineering to develop a detailed study of Soyuz Spacecraft In-Space Inspection. As a senior project engineer for technology applications in the Strategic Opportunities and Partnership Development Office of the Johnson Space Center. In the past 20 years, he has championed numerous successful wireless flight instrumentation projects for dual-purpose technology -operational use demonstrations on Space Shuttle Orbiters and International Space Station. Applying the lessons learned, he has promoted changes to future vehicle architectures to enable reduced wires and connectors through a comprehensive approach called "Fly-by-Wireless".

Tues, Dec 15th, PWS1-1b, 10:30am

"A Review of SAW Sensor Technology"

Arthur Weeks **University of Central Florida, Orlando**
Arthur.weeks@ucf.edu **Assoc. Professor, Electrical and Computer Engineering**
407-823-0767 **http://www.ece.ucf.edu/**

Abstract:

Surface Acoustic Wave (SAW) Sensor development has led to passives devices capable of measuring temperature, strain, and gas variations. This talk will present a review of SAW device technology and systems for use as a passive wireless sensor. Background material will be presented that discusses the technical issues associated with using these devices as passive sensors. An example system interrogator (composed of a transmitter and a receiver) used to measure the SAW sensor's data will also be presented. The discussion of the receiver section of the interrogator will include the various performance issues (such as SNR). Coding techniques will be discussed that encompasses both orthogonal frequency and time coding methods so that multiple sensors can be used by the same interrogator system. The talk will conclude with a demonstration of a wireless SAW temperature sensor system.

Background:

Arthur R. Weeks received his M.S.E and Ph.D. degrees in Electrical Engineering from the University of Central Florida in Orlando in 1983 and 1987, respectively. After completion of his Ph.D., he spent approximately one year at the Royal Signals and Radar Establishment in Malvern, England studying enhanced backscattering and laser beam propagation. He joined the Electrical and Computer Engineering Department at the University of Central Florida in 1989, where he is now an Associate professor. He has written numerous papers on image processing and laser beam propagation and has co-authored two additional texts in image processing, *Computer Imaging Recipes in C* and *The Pocket Handbook of Image Processing Algorithms in C*. He has taught numerous short courses for SPIE in image processing and is currently an associate editor of the SPIE/IS&T Journal of Electronic Imaging. His current research interests include RF communications, wireless sensors and Software Defined Radio. He is also interested in color image processing, and image enhancement using nonlinear filters. Dr. Weeks is also a member of the IEEE and SPIE.

Tues, Dec 15th PWS1-2 11:00am

"On low cost ubiquitous sensor networks: DOE needs and application areas"

Tim McIntyre **Program Manager, Energy & Environmental Sensors**
mcintyretj@ornl.gov **DOE/Oak Ridge National Laboratory (ORNL)**
(865) 576-5402

Abstract:

Ultra-low cost sensors hold the potential for broad impacts across the energy and environmental sectors. This talk presents a few examples of high impact applications for low-cost sensors and some technology development activities underway at Oak Ridge National Laboratory to address these needs.

Background:

Tim McIntyre is a senior research staff member and Energy & Environmental Sensors Program Manager in the Electrical and Electronic Systems Research Division at Oak Ridge National Laboratory (ORNL). Tim's research activities at ORNL span >25 years and include nano-technology, optical and physical sensors, sensor networks, wireless communications, energy harvesting, and most recently, zero-power sensors. Tim's work has produced 19 inventions disclosures, resulting in 7 patents and >50 publications, proceedings and invited talks. Tim also served as the Department of Energy Liaison to the National Academy of Sciences' seminal report on industrial wireless sensor technology for energy efficient process control.

Tues, Dec 15th, PWS 1-3, 11:30am

"Inflatable Reentry Vehicles and Instrumentation Needs"

Robert Dillman
Robert.a.Dillman@nasa.gov **NASA Langley Research Center, Hampton, VA**
757-864-7177 **Hypersonic Inflatable Aerodynamic Decelerator(HIAD) Program**

Abstract

NASA Langley has been working on the development and testing of Hypersonic Inflatable Aerodynamic Decelerators (HIADs) for over 10 years. These vehicles enable the delivery of larger payloads to higher altitudes on Mars, and can also be used to protect payloads during reentry from Earth orbit. This presentation discusses the development history of HIADs, their ground test and flight environments, and their needs for enhanced sensors for upcoming missions.

http://www.nasa.gov/directorates/spacetech/game_changing_development/HIAD/index.html#.VlTSYXarTEY

Background:

Robert Dillman has been a flight hardware engineer at NASA Langley Research Center since 1989. He has a Bachelor of Science in Aerospace Engineering, and a Masters of Materials Science, both from the University of Virginia. He was project chief engineer for IRVE-II and IRVE-3, the first two fully successful flight tests of inflatable reentry vehicle technology.

Tues, Dec 15th, PWS2-1, 1:30pm

"Aircraft Wireless Tire Pressure Sensing and the Harsh Environmental Constraints Associated with Landing Gears."

Andrew Bill **Landing Gear Monitoring Specialist and ATA32 R&T Engineer**
andrew.r.bill@airbus.com **Airbus Operations, Ltd, Filton, Bristol, UK**
44 (0) 117 936 2166

Abstract:

In this presentation Andrew intends to provide the respective audience with an insight into why frequent aircraft tire pressure monitoring is necessary and the subsequent consequences of either poor maintenance or system unreliability. He will present some of the tire pressure sensing methods currently being used today along with the problems encountered due to the complexities of wheel-axle equipment integration in combination with the harsh environment associated with aircraft landing gears. He will then discuss the benefits, nuances and challenges associated with wireless tire pressure sensing including the additional challenges to safety and security that a wireless interface brings.

Background:

Andrew Bill was born in Leicester City, United Kingdom, in 1974. He received his Bachelor of Engineering degree with honours in aerospace engineering from the University of Hertfordshire, in 1998. From 1999 to 2001, he was a control systems engineer for Dowty Propellers, working on the Bombardier Dash 8-400 propeller control system. From 2001, he has been a systems engineer at Airbus in Filton, UK, and supported the development of the braking and steering systems for the Airbus 380. In 2004 he joined the Landing Gear Monitoring Systems team at Airbus as an engineering specialist. He developed the Brake Monitoring System, Oleo Pressure Monitoring System, Tire Pressure Indication System and the Brake Cooling Fan Control Systems for the Airbus A380 and Airbus A350 aircraft. Since 2014, he has been a systems specialist for the Landing Gear Research and Development Department at Airbus.

Tues, Dec 15th, PWS2-2, 2:00pm

"Wireless Avionics Intra-aircraft Communications (WAIC) for Commercial Aircraft"

David Redman **Director, Aerospace Vehicle Systems Institute (AVSI)**
dredman@avsi.aero **www.avsi.aero**
979-862-2316 979-218-2272

Abstract:
Wireless Avionics Intra-Communications (WAIC) systems will liberate aircraft safety service interconnections from tethered wiring, offering designers and operators opportunities to improve flight safety, reliability, and operational efficiency. By reducing the overall system weight, wireless provides fuel reduction and subsequent environmental benefits, supporting more cost-effective flight operations. WAIC also supports reduced complexity of aircraft design and manufacture, lowers maintenance costs, and yields greater flexibility to enhance aircraft systems that maintain or increase the level of safety, thereby improving an aircraft's performance over its useful lifetime. The AVSI WAIC team worked with various national administrations over the past 7 years to establish an Agenda Item (AI 1.17) at the World Radio Conference 2012 (WRC-12), and then provided thorough analyses and proof of non-interference co-existence through the ITU-R Working Party 5B to successfully obtain an allocation of dedicated spectrum for WAIC in the candidate 4200-4400 MHz band at WRC-15 under this Agenda Item. The 4200-4400 MHz band was exclusively reserved for radar altimeter applications prior to this allocation. Under AVSI project AFE 76 – *WAIC Protocols*, detailed network and hardware architectures, protocols, requirements, and appropriate protection criteria for spectrum sharing are being defined to protect WAIC and legacy altimeter systems from interfering with each other. WAIC applications have been categorized as either Low Rate (< 10kbits/sec data transmit rate) or High Rate (>10 kbits/sec), each having some unique SWaP, cost, and performance requirements. AFE 76 is now addressing more detailed design issues, including: system boundaries where WAIC standards might be applied; plans for WAIC spectrum assignments to ensure efficient usage; channel allocation and channel spacing scheme for WAIC systems; methods for achieving coexistence between WAIC systems installed on different aircraft; and a road map for working with international regulatory and standards organizations to ultimately implement WAIC components and systems.

Background:

Dr. David Redman was appointed Director of the Aerospace Vehicle Systems Institute (AVSI) in August 2008. Prior to that, David spent seven years working for Smiths Aerospace/GE Aviation in Grand Rapids, Mich., where he held several positions, including Directorate Staff Engineer of Special Projects and Intellectual Property Development and Acting Engineering Director/Department Manager. Additionally, Redman has worked for Kysor Medallion/Borg Warner in Spring Lake, Mich., and was an adjunct professor of Physics at Idaho State University.

Tues, Dec 15th PWS2-3, 2:30pm

"Partnership Opportunities with AFRC for Wireless Systems Flight Testing"

Richard Hang **Chief, Sensors and Systems Development Branch**
richard.hang-1@nasa.gov **NASA Armstrong Flight Research Center**
661-276-2090 **http://www.nasa.gov/centers/armstrong/home/index.html**

Abstract:

The presentation will overview NASA Armstrong Flight Research Center's flight test capabilities, which can provide various means for flight testing of passive and active wireless sensor systems. Also, it will share the constraints and requirements of wireless sensor systems used for flight test application as solutions to the issues of the conventional flight instrumentation methodology, such as additional weight caused by added instrumentation wire bundles, connectors, wires/cables routing, moving parts, hard to reach places, etc., in which, the passive wireless sensor technology may help.

Background:

Richard Hang currently serves as the Chief of the Sensors and Systems Development Branch (Code RD) at the NASA Armstrong Flight Research Center (AFRC). Before leading Code RD, he served as the Chief of the Flight Instrumentation Branch for two years. He was a senior engineer on open architecture real-time embedded data systems development for over 15 years prior to becoming supervisor. Richard aims to doing in-house research and development of wireless sensors/systems, or using available COTS devices to solve issues raised by the conventional flight instrumentation methodology.

Tues, Dec 15th, Plenary 5; 3:30pm

"NASA Aeronautics Strategic Direction and Aeronautical Research Programs"

Mr. Jay E. Dryer **Director, Advanced Air Vehicles Program (AAVP)**
NASA Aeronautics Research Mission Directorate (ARMD)

Abstract:

Jay Dryer will offer a perspective on the NASA Aeronautics Strategic Direction and how the Aeronautical Research Mission Directorate programs are focused to align with this strategy. He will summarize the general partnership strategies and how the portfolio is managed - providing valuable insight into how certain technologies (e.g. wireless technologies) might fit. For more background, see the Advanced Air Vehicles website (http://www.aeronautics.nasa.gov/programs-aavp.htm) and check out the NASA Aeronautics Strategic Implementation Plan (http://www.aeronautics.nasa.gov/pdf/armd-strategic-implementation-plan.pdf).

Background:

Mr. Jay Dryer is responsible for the overall planning, management and evaluation of the directorate's efforts to develop tools, technologies, and concepts that enable new generations of civil aircraft that are safer, more energy efficient, and that have a smaller environmental footprint. The program works to achieve major leaps in the performance of all types of air vehicles. Before joining NASA, he worked briefly in the private sector and before that was an officer in the U.S. Navy serving in assignments in submarines, deep submergence and with the Navy Special Forces. Mr. Dryer holds a bachelor's of science degree in systems engineering from the U.S. Naval Academy and a master's of science degree in ocean engineering from Massachusetts Institute of Technology.

Tues, Dec 15th, Plenary 6, 4:00pm

"NASA Experimental Program to Stimulate Competitive Research (EPSCoR)"

Jeppie Compton
Jeppie.R.Compton@nasa.gov
321-867-6988

NASA EPSCoR Project Office
National Project Manager, NASA EPSCoR
Kennedy Space Center, FL

Abstract: Public Law 102-588, passed in 1992, authorized NASA to initiate NASA EPSCoR to strengthen the research capability of jurisdictions that have not in the past participated equably in competitive aerospace research activities. The goal of NASA EPSCoR is to provide seed funding that will enable jurisdictions to develop an academic research enterprise directed toward long-term, self-sustaining, nationally-competitive capabilities in aerospace and aerospace-related research. This capability will, in turn, contribute to the jurisdiction's economic viability and expand the nation's base for aerospace research and development. The specific objectives of NASA EPSCoR are to 1). Contribute to and promote the development of research capability in NASA EPSCoR jurisdictions in areas of strategic importance to the NASA mission; 2). Improve the capabilities of the NASA EPSCoR jurisdictions to gain support from sources outside the NASA EPSCoR program; 3). Develop partnerships among NASA research assets, academic institutions, and industry; and 4). Contribute to the overall research infrastructure, science and technology capabilities and economic development of the jurisdiction;

Background:

JEPPIE COMPTON is the NASA National Project Manager for the Experimental Program to Stimulate Competitive Research (EPSCoR) responsible for awarding and managing research grants with 28 States, Puerto Rico and the US Virgin Islands. He is also a former NASA senior safety engineer at the Kennedy Space Center and director of Florida operations for All Points Logistics, Inc overseeing 9 contracts at KSC. He is a retired Air Force officer with a bachelor's degree in Meteorology from the University of Utah and a master's degree, also in Meteorology, from St Louis University. He has considerable experience in program management on the space shuttle program, the constellation program, numerous satellite programs, and with both air and sea unmanned vehicle programs. He managed space station, work package II systems engineering projects for McDonnell Douglas and human life sciences projects for Lockheed Martin at the Johnson Space Center. He has a long history in modeling and simulation and implemented the Rocket Exhaust Effluent Diffusion Model (REEDM) on the Air Force's Eastern Range.

Dec 15th, 4:20-5:00pm WiSEE 2015 Panel Discussion

On "Wireless and Less Wires-Connectors-Penetrations"

Questions for the panel:

1. What is the **greatest need** in this area for in your organization/industry?
2. What has been the **greatest impediment**(s) in this area for your org/industry?
3. What are the **technology & application trends** in this area in your org/industry?

Moderator
George Studor, NASA
Eng & Safety Center

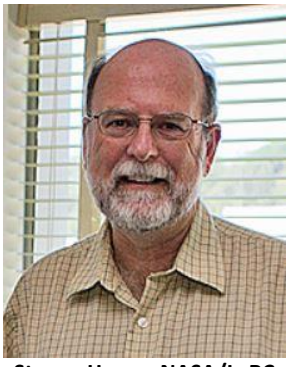
Panelists:

Jay Dryer, NASA HQ
Director, Advanced Air Vehicles Program

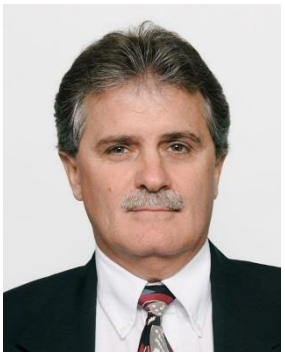
Andrew Bill, Airbus
Landing Gear R&D Systems Specialist

David Redman, Director
Aeronautical Vehicle Systems Institute(AVSI)

Jeppie Compton, NASA/KSC
Director, National EPSCOR Program



Steven Horan, NASA/LaRC
PT for Game-Changing Development Program



James Larkin, AR
Aerojet Rocketdyne DPHM lead

Tim McIntyre, DOE/ORNL
Energy & Environmental Sensors Program

Kim Simpson, NASA/JPL
Future Habitat Systems Engineering

Brian Hall, NASA/Wallops
Orbital Projects Manager Sounding Rocket Program

Robert Dillman, NASA/LaRC
Hypersonic Inflatable Aerodynamic Decelerators

Leo Fabinski, NASA/MSFC
MSFC Engineering Advanced Concepts Office

Rich Evans, NASA/GRC
Space Power Facility (SPF) Instrumentation Manager

Tues, Dec 15th 5:10 – 6:00pm One-on-One Sessions

Purpose: Initiate relationships that may enable future wireless capability
Method: Users/Stakeholders have an assigned table to sit at
Less Wire Developers/Providers sign-up to meet with Users on an "as available" basis.
Scheduling: A spreadsheet for Tuesday slots will be made available at the registration desk to sign up on the User's schedule.
User and Developer/Provider must keep to the schedule
Moderator will announce the times to "move-on"

Tues PM	5:10-5:20	5:20-5:30	5:30-5:40	5:40-5:50	5:50-6:00
Wed PM	12:30/Lunch	12:45-1:00	1:00-1:15	1:15-1:30	1:30-1:45
	(User choice)				
Wed PM	1:45/Break	2:00-2:15	2:15-2:30	2:30-2:45	2:45-3:00
	User choice				
	(User choice)				
Conference Ends at 3pm					

Wed, Dec 16th, Plenary 7, 8:00am

"Optical Wireless, Theory and Applications"

Professor Mohsen Kavehrad **Penn State University – EE Dept.**
mkavehrad@psu.edu **Center for Information & Comm. Technology Research (CICTR)**
(814) 865-7179 **http://cictr.ee.psu.edu/**

Abstract: Demands by the communications industry for greater and greater bandwidth push the capability of the conventional wireless technology. Optical systems and networks offer a far greater bandwidth. This means that new devices and systems have to be developed. Semiconductor Light Emitting Diode (LED) is considered to be the future primary lighting source for buildings, automobiles spacecraft and aircrafts. LED provides higher efficiency compared to incandescent and fluorescent light sources and it will play a major role in the global reduction of carbon dioxide emissions, as a consequence of the significant energy savings. Lasers are also under investigation for similar applications. These core devices have the potential to revolutionize how we use light, including not only for illumination, but also for communications, sensing, navigation, positioning, surveillance, and imagining. This presentation covers the evolutionary path of the field.

Background:

Dr. Mohsen Kavehrad, is the W. L. Weiss Chair Professor of Electrical Engineering at The Pennsylvania State University and serves PSU as Director of the Center for Information and Communications Technology Research (CICTR), and the NSF-sponsored Center on Optical Wireless Applications (COWA). After a long history of IEEE responsibilities, Dr. Kavehrad continues as an IEEE Fellow and Distinguished Lecturer. He is also currently on the Editorial Board of the International Journal of Wireless Information Networks, supports international conferences and workshops and continues to provide consulting services as time permits. Dr Kavehrad is an international leader in networked systems using broadband wireline, wireless and optical communications, having experience in their application to satellites, fixed, portable and mobile radios, atmospheric laser communications and fiber optic networks. Mohsen's experiences include work at Fairchild Industries, GTE, Bell Labs, AT&T Shannon Research Labs., Tele-Beam, University of Ottawa, Telecommunications Research Institute of Ontario, Ottawa-Carleton Communications Center for Research, NORTEL-Ottawa, and NTT Laboratories-Japan. Dr. Kavehrad received his Ph.D. degree in Electrical Engineering from the Polytechnic Institute of New York University in 1977. Full Vitae: http://cictr.ee.psu.edu/facstaff/kavehrad/index.html
Dr, Kavehrad's latest book, "Short Range Optical Wireless: Theory and Applications," was just released, Nov. 16, 2015.

Wed, Dec 16th, Plenary-8, 8:45am

"The NASA and LVX System Partnership for Development of Light Communications Technologies"

Jack J. Fox
jack.j.fox@nasa.gov
321-867-4413
Chief, Science and Technology Projects Division
Exploration Research and Technology Programs
NASA, Kennedy Space Center, FL
http://appel.nasa.gov/2013/08/12/back-to-the-future-ksc-swamp-works/

Abstract:

Background:

Jack J. Fox is chief of the Science and Technology Projects Division in the Exploration Research and Technology Programs Directorate at NASA's John F. Kennedy Space Center (KSC), Florida. The division conducts science, research and technology development of surface systems for planetary bodies, their moons and Near Earth Objects. Specialty areas include: soil mechanics; regolith excavation and transport, landing pads and berms, rocket exhaust plume modeling, in situ resource utilization processes, environmental remediation, electrostatic charge mitigation, dust mitigation, energy-efficient solutions for cryogenic systems, corrosion protection, polymer science, materials chemistry, and novel composite systems.

Fox began his career with NASA in 1983 after receiving a Bachelor of Science degree in Aeronautical and Astronautical Engineering from The Ohio State University. He later received a Master of Science degree in Engineering Management from the University of Central Florida. His experiences include serving as flight systems engineer for Space Shuttle Orbiter and Solid Rocket Booster Auxiliary Power Unit and Hydraulics Subsystems, Space Shuttle Orbiter and Payloads project engineer and project manager, Technology Projects Office chief, Deputy Director of External Relations, Constellation Program facilities manager at NASA Headquarters, and Business Office chief for the Engineering and Technology Directorate. He is also a member of the American Institute for Aeronautics and Astronautics and NASA Speakers Bureau. Fox has received numerous honors including several "On The Spot" Awards, Group Achievement Awards, Center Director's "Gold Dollar," Space Flight Awareness Award, Astronauts' Office "Silver Snoopy" Award, and the NASA Exceptional Service Medal.

Wed, Dec 16th, PWS3A-1, 10:00am

"Cryogenic Applications for Wireless Power and Data using Magnetics"

Garrick Merrill — **Digital Design Engineer**
garrick.merrill@nasa.gov — **ES36/Space Systems, Electronic Design Branch**
256-544-4409 — **Engineering Directorate, NASA Marshall Space Flight Center**

Abstract:

Abstract: Hydro Technologies has developed a wireless sensor system that both receives data and transmits power through a solid medium. They believe their system, which was developed for oil pipelines, can be adapted to work through fuel tank walls. This technology can reduce or eliminate the need for protrusions in fuel tanks for sensor wires. Fewer protrusions reduces leakage rates and makes for a safer tank. Beyond uses in NASA vehicles, orbital fuel depots and commercial launch vehicles could benefit from this technology and simplify their tank design. Less protrusions in a tank simplify manufacturing, testing, increase safety, and reduce leak rates. At Marshall Space Flight Center we're focused on adapting this technology for cryogenic applications. We've performed cryogenic testing and are working with Hydro Technologies to adapt the design for aerospace use.

Background:

Mr. Merrill has more than 13 years of design, development, and testing experience in digital systems, including processors, microcontrollers, Field Programmable Gate Arrays (FPGA), and wireless network technologies. Recent work includes digital board design for multiple projects including Advanced Neutron Spectrometer, Software Integration Lab, and Lunar Prospector. He has been actively researching reconfigurable, robust physical computing, and wireless mesh networks since 2009. He is also currently supporting projects that are utilizing the MSFC Team Aero-M Unmanned System lab as the avionics lead and chief pilot. This includes the 2014-2015 Formation Flying TIP as the Principal Investigator as well as the 2016 CAN proposal for Lunar Sensor testing.

Wed, Dec 16th, PWS3A-2, 10:30am

"Ultrasonic Communication for High-Data Rate Through-Metal Applications"

Cem Sahin
cs486@drexel.edu
215-895-6428

Research Associate, Drexel Wireless Systems Lab
Drexel University, Philadelphia, PA, USA
http://wireless.ece.drexel.edu/

Abstract:

In this presentation we will discuss various ultrasonic communication techniques that yield high-data rate in through-metal applications. There currently is a need for ultrasonic communication applications in scenarios where structural integrity is essential and limits are imposed in terms of installation of new equipment. Although ultrasonic communications offer solutions to such barriers, challenges, such as high inter-symbol interference (ISI) are encountered in through-metal environments using high-data rates. At Drexel University, we have developed several channel equalization techniques to combat these challenges and demonstrated rate in excess of 30 Mbps through ¼" steel plate. We have tested our solutions using low-cost software-defined radios (SDR). Our testbed offers many research and rapid prototyping capabilities including through-metal communications involving curved surfaces. Drexel University holds several patent applications supporting our ultrasonic research and development and are looking for industrial partners for commercialization or further research opportunities.

Background:

Cem Sahin received his Bachelor's degree in Computer Engineering from Drexel University in 2011 with Summa Cum Laude. He continues to pursue his Ph.D. degree in Electrical Engineering at Drexel University under his advisor Dr. Kapil Dandekar (dandekar@coe.drexel.edu). He is currently a Research Associate at Drexel Wireless Systems Lab. His research interests include through-metal communications, wireless communications, physical layer security, and engineering and cybersecurity education. He enjoys teaching and hopes to enter a career in academia upon graduation.

Wed, Dec 16th, PWS3A-3, 11:00am

"Acoustic Data and Power Transmission Through & Along Solid Structures"

Kyle Wilt **Research Engineer**
wiltk2@rpi.edu **Rensselaer Polytechnic Institute, Troy, NY**
518-276-8140

Abstract:

There are many applications where wireless sensors that are generally interrogated using electromagnetic waves will fail, such as when the sensors are isolated by Faraday shielding. Examples include cases where the sensors are contained within or reside outside metallic pressure vessels or rebar-reinforced structures. At Rensselaer, we have developed several alternative wireless implementations which employ ultrasonic waves in place of electromagnetic waves for use in such situations. Most implementations also allow for wireless power delivery to the sensor in order to enable long term operability of the sensor without the requirement of a significant battery bank. These ultrasonic systems have been tailored to various application specific requirements, such as low-power (a few milliWatts) and high-power (10's of Watts) delivery, low-rate (100's of bits per second) to high-rate (10's of megabits per second) data transmission, as well has half- and full-duplex communication routines. A review of the capabilities developed at Rensselaer will be discussed, including technologies capable of operating directly through a wall, as well as those that operate along a structure.

Background:

Kyle Wilt is currently a research engineer in the Mechanical, Aerospace, and Nuclear Engineering Department at Rensselaer Polytechnic Institute (RPI) and is a co-principal investigator for Rensselaer's Ultrasonic Through-Wall Communications (UTWC) group. He is primarily focused on the research and development of wireless ultrasonic power and data transmission systems, where he contributes to all aspects of the design, including the development of power transmission and reception circuitry as well as low- and high-rate communication routines, though he contributes most significantly to the mechanical construction of the systems. More specifically, he specializes in the configuration and design of the acoustic/ultrasonic transmission path which involves substantial work with bulk wave piezoelectric transducers. Additionally, he provides research guidance to the UTWC group's undergraduate and graduate students and is also a contributor to GE's Fan Test Facility at Rensselaer. Kyle received both his B.S. (2006) and Ph.D. (2012) in mechanical engineering from Rensselaer.

Wed, Dec 16th, PWS3A-4, 11:30am

"Robust UWB Communication in Large Ship Interiors"

Farid Dowla **Research Scientist, Lawrence Livermore National Laboratory**
dowla@alum.mit.edu
925-423-7579

Abstract:

The UWB radio communications can be used for robust non-line-of-sight wireless communications in large ships using low-cost, small form-factor, battery-powered electronics. Ultra-wideband communications (or impulse radio) uses short (~1 ns) pulses rather than a narrowband carrier frequency to transmit information. It can provide highly covert short range (<1 km) communications at moderate data rates in multipath and extreme clutter environments, such as in ships. In this presentation we discuss some of the well-tested methods for system we have recently designed, including the use of transmitted-reference modulation schemes. We also compare the performance of UWB and narrowband systems in the same noisy multipath environment.

Background:

Farid U. Dowla received his B.S. (1978), M.S. (1981), and Ph.D. (1985) degrees in electrical engineering from the Massachusetts Institute of Technology and is currently Senior Research Engineer at the Lawrence Livermore National Laboratory (LLNL) and has been at LLNL for 30 years. He is also an Adjunct Professor at the University of California, Santa Cruz. His research experience includes ground-penetrating and building penetrating radar imaging, including work with DARPA and NNSA projects related to high-resolution deep GPR imaging systems. His expertise also includes wireless communication networks, RF, and DSP; Signal processing for CTBT seismic monitoring systems, and acoustic applications; array and antenna design, adaptive noise cancellation, signal and image compression, neural networks, optimization; and terahertz and RF imaging. Dr. Dowla has authored multiple books and publications and currently holds over ten patents.

Wed, Dec 16th, PWS2B-2, 10:00am

"A Spacecraft Backbone - Plug 'n' Play Concepts for a Deep Space Habitat"

Ms. Kimberly Simpson
kimberly.a.simpson@jpl.nasa.gov
818-354-0885

NASA Engineering and Safety Center
Systems Engineering Technical Discipline Team
Verification and Validation Co-lead
Jet Propulsion Laboratory

Abstract:
NASA is developing capabilities needed to carry humans to Mars and back in the 2030s. To enable these missions, the Human Exploration and Operations Mission Directorate (HEOMD) has defined a set of goals and multi-phased development plan that includes missions in cislunar space to demonstrate and validate hardware and operational techniques in a "proving ground" that is more relevant to Mars than Low Earth Orbit. Each mission in the proving ground will build on the ones that came before it, to enable longer duration missions while reducing reliance on Earth-based systems. One aspect of the multi-phased plan is to develop an evolvable architecture which minimizes unique major developments, demonstrates application of common design standards and evaluates the cislunar transit habitat architecture for ease of adaptability and evolution, including partnership additions that can support both lunar surface access and Mars transit missions. This talk will provide an overview of the some of the work being performed to define a "spacecraft backbone" and plug 'n' play concepts followed by an open discussion on the cislunar habitat as a potential wireless user.

Background:

Kim Simpson has over 28 years of systems engineering experience, 9 specifically in the systems engineering and integration of human exploration's complex cross-program mission interfaces. Her most recent focus has been working within the Human Exploration Mission Operations Directorate (HEOMD) Multi-Purpose Crew Vehicle (MPCV) Flight Test Management Office (FTMO) as the lead of the development, design, verification, validation of the Exploration Flight Test 1 (EFT-1) Integrated Network which successfully performed all command, telemetry, voice, video and imagery data processing throughout the December 5th, 2014 mission. Following the successful EFT-1 mission, Kim is now applying experiences gained from the Orion test flight to better understand Exploration Mission 1 and 2 software and avionics risks as the NASA Engineering & Safety Center (NESC) Systems Engineering Technical Discipline Verification & Validation co-lead. She additionally supports Skip Hatfield's Future Capabilities Definition Team (FCDT) developing a plug 'n' play spacecraft bus architecture for the cislunar habitat. Through extensive use of model-based systems engineering techniques she has demonstrated an increase in affordability, achieved interoperability within and amongst program/ projects, centers and external partners and trained multiple users on the benefits of model-based systems engineering.

Wed, Dec 16th, PWS3B-2, 10:30am

"Software Defined Radio Approach for Passive, Wireless RFID Sensors"

James "Trip" Humphries **Graduate Research Student, EE**
james.humphries@knights.UCF.edu **Univ of Central Florida**

Abstract:

Passive, wireless sensor design typically dictates many strict performance requirements for the sensor interrogation system in terms of bandwidth, output power, and data capture rate. In the past, this implied that a custom interrogator design would need to be implemented, requiring considerable time and effort as well as being unable to adapt to new sensor requirements. Recent advances in commercial-off-the-shelf (COTS) software defined radio (SDR) platforms have enabled rapid interrogator development while being able to meet the strict requirements of passive, wireless RFID sensor tags. At the University of Central Florida, we have utilized the universal software radio peripheral (USRP) B200, from Ettus Research, to implement a pulsed interrogation system for wideband, wireless surface acoustic wave (SAW) RFID sensors. In this talk, we will discuss the implemented SDR system with consideration given to FPGA modifications, external RF component integration, and post-processing. The system operates at 915MHz with 56MHz bandwidth and has output power of greater than +20dBm. A demonstration of the system will also be given with wireless SAW temperature sensors.

Background:

James 'Trip' Humphries was born in Ft. Walton Beach, FL, in 1987. He received the B.S. (2010) and M.S. (2012) degrees in electrical engineering from the University of Central Florida, Orlando. He is currently pursuing the Ph.D. degree in electrical engineering at the University of Central Florida. He is a graduate research assistant at the University of Central Florida. His research interests include wireless surface acoustic wave (SAW) sensors, software defined radio (SDR) applications, and microelectronic device fabrication. Mr. Humphries is a recipient of the NASA Graduate Student Researchers Program (GSRP) Fellowship with the task of designing a passive, wireless strain sensor. His other awards and honors include student paper competition finalist at IEEE IFCS 2012 as well as the IEEE MTT-S undergraduate scholarship.

Wed, Dec 16th, PWS3B-3, 11:00am

"Passive RFID Sensing for Harsh Environments - LLNL-Dirac Platform"

Faranak Nekoogar
nekoogar1@llnl.gov **Lawrence Livermore National Labs**
925-423-3148

Abstract:

In many practical applications, there is an important need to use passive (battery-free) RFID tags that operate reliably in harsh environments. Although passive tags have clear advantages over active (battery-powered) tags, to date most passive RFID tags face significant performance challenges in the presence of heavy reflective (metallic) and cluttered environments. In this talk we discuss the challenges of addressing such applications and present the results of using LLNL-DSI passive RFID system developed specifically for hostile environments in various applications including the helicopter rotor head.

Background:

Faranak Nekoogar, Ph.D. is the lead researcher on Ultra-wideband Technology at Lawrence Livermore National Laboratory. Her areas of research include wireless communications and radio frequency identification (RFID) for hostile environment, as well as radar systems for target detection and underground imaging. Dr. Nekoogar has over 20 years of experience in wireless research, product/business development, and management combined with Chip design and verification skills. She holds a PhD in Electrical Engineering from UC Davis and has authored of 4 technical books, and 21 patents/records of inventions in the area of wireless technology. Faranak has been at LLNL for the past 12 years, and prior to LLNL, she had many years of experience in design and verification of electronics microchips in various companies in Silicon Valley, CA including: NASA Ames Research Center, Amphion Semiconductor, and had consulting roles with companies such as Lucent Technologies, Philips Semiconductor, S3 Corporation, IBM (Mylex), Qualcomm Corp.

Wed, Dec 16th, PWS3B-4, 11:30am

"Improving Performance of Passive RFID-based Part-DNA for Rotor-head Maintenance Application"

Maciej J. Zawodniok **Assistant Professor, Computer Engineering**
mjzx9c@mst.edu **NSF I/UCRC on Intelligent Maintenance Systems**
573-202-0378; (573)-341-4361 **http://ims.mst.edu/** **University of Missouri-Rolla**

Abstract:

RFID technology has been employed in several different applications, yet their ability to be utilized in dynamic environments is hindered by unreliable read-rate. Passive RFID tags suffer from RF interference and mutual coupling effects with surrounding objects and neighboring tags. The negative effect on performance is especially pronounced when the tag is attached to ferromagnetic (metallic) objects. A novel approach is proposed to improve performance of RFID system in such a challenging and dynamic environment. The proposed Impedance Switching Network (ISN) supports dynamic control of impedance attached to the RFID tag antenna to counter the effect of interference and mutual coupling. By choosing the best impedance the energy harvested by the RFID tag is maximized. The proposed ISN design is integrated with a WISP platform that implements a standard RFID Gen 2 communication protocol. Simulation and experimental results demonstrate improved performance of RFID system in the metal-rich environment including a helicopter rotor-head. The ISN is able to remove the negative impedances and maximize energy harvesting at the RFID tag.

Background:

Maciej J. Zawodniok (S'03, M'06) graduated from the Silesian University of Technology with a Master of Science degree in Computer Science in 1999 and received a Ph.D. degree in Computer Engineering from the University of Missouri-Rolla in 2006. Since 2008, he is at Missouri University of Science and Technology, where currently he is an Assistant Professor in Computer Engineering and Assistant Director of NSF I/UCRC on Intelligent Maintenance Systems.

He has co-authored around 25 peer-reviewed journal articles and book chapters, over 35 refereed IEEE conference articles. Also, he received the prestigious NSF CAREER award in 2010 for his research on improving performance of passive RFID systems. Dr. Zawodniok's research focuses on adaptive and energy-efficient protocols for wireless networks, network-centric systems, network security, cyber-physical and embedded systems with applications to manufacturing and maintenance.

Wed, Dec 16th, PWS3C-1, 10:00am

"The NASA Sounding Rocket Program and Technology Needs"

Brian Hall **NASA Sounding Rocket Program, Technology Manager**
brian.a.hall@nasa.gov **Wallops Flight Facility, VA**
757-824-1477

Abstract:

In this presentation, we will discuss the NASA Sounding Rocket Program and technology development. The overview of the NASA Sounding Rocket Program will include core capabilities of the program, technology needs, as well as opportunities for technology demonstration on sub-orbital sound rocket mission.

Background:

Brian Hall currently serves as a Technology Manager in the NASA Sounding Rocket Program located at NASA Goddard Space Flight Center's Wallops Flight Facility. Mr. Hall is responsible for managing the development of technologies to maintain and enhance the capabilities of the Program. Mr Hall works closely with the science community, NASA engineering, the NASA Sounding Rocket Operations Contract, and the Sounding Rocket Program Office to develop technology plans for the Program.

Mr. Hall is a graduate of North Carolina State University with a B.S. in Civil Engineering. Shortly after beginning his career in Civil Engineering at Wallops Flight Facility, he was offered the opportunity to support the Mechanical Engineering Branch. He continued serving as a Mechanical Engineering in the Sounding Rocket Program until 2004 when he accepted a civil servant position with the Wallops Range and Mission Management Office. In this position, Mr. Hall was responsible for project management for sounding rocket, unmanned aerial systems, target drones, and aircraft testing initiatives for range of customers in government, industry, and academia. In 2009, Mr. Hall accepted a position in the Sounding Rocket Program Office serving as the Technology Manager.

In addition to supporting the Sounding Rocket Program Office and Wallops Research Range, Mr. Hall supported several NASA technology development programs. He served as the Vehicle Manager for the Max Launch Abort System, MLAS, which was a risk reduction effort for the Constellation Program launch abort system led by the NASA Engineering & Safety Center. Mr. Hall later served, in a temporary capacity, as the Orbital Projects Manager for the Sub-Orbital and Special Orbital Projects Directorate. In this role, Mr. Hall led WFF's efforts to develop and implement small satellite carrier systems and evaluate new business opportunities. More recently, Mr. Hall served as the project manager for the launch services and flight avionics on the Low Density Supersonic Decelerators Project in support of Mars Entry, Descent, and Landing technology demonstration.

Wed, Dec 15th, PWS3C-2, 10:30am

"Aerojet Rocketdyne Propulsion System PWST Needs/Challenges"

James Larkin Diagnostics, Prognostics & Health Management (DPHM) Discipline Lead
James.Larkin@rocket.com Aerojet Rocketdyne, West Palm Beach, FL
561-882-5370

Abstract:
Aerojet Rocketdyne (AR) provides a wide variety of propulsion systems which could benefit from passive wireless sensor technology (PWST). Three types of rockets/motors are addressed in the presentation: Solids, Liquids and Air-breathing Hypersonics. Descriptions of each type are provided, along with example applications. PWST needs and challenges are then discussed, as they relate to defining propulsion system heath status.

Background:

Mr. James Larkin is the Diagnostics, Prognostics & Health Management (DPHM) Discipline Lead at Aerojet Rocketdyne, where he is responsible for advancing hardware and software capabilities to improve mission safety, reliability, performance and maintainability. James has 28 years of experience in the aerospace industry. He started his career in the Pratt & Whitney military jet engine business, and later migrated to the space propulsion sector, which ultimately became Pratt & Whitney Rocketdyne. Two years ago, Aerojet Rocketdyne was formed. James has designed and tested Full-Authority Digital Electronic Controller (FADEC) logic/software, while focusing on engine health management systems (EHMS) and integrated vehicle health management (IVHM). He served as the integrated product team lead for real-time fault detection and accommodation (FDA) and event detection and accommodation (EDA) hardware/software systems across numerous platforms, including commercial and military gas turbine programs, NASA rocket programs, and an Air Force Research Lab hypersonic program. Mr. Larkin is an active leader in the Joint Army-Navy-NASA-Air Force (JANNAF) community, as well as the Prognostics & Health Management (PHM) Society. He holds a B.S. in Aeronautical Engineering and a B.S. in Aeronautical Studies from Embry-Riddle Aeronautical University.

Wed, Dec 16th, PWS3C-3, 11:00am

"4 High Value Wireless Applications at Marshall Spaceflight Center with their Challenges"

Leo Fabisinski **MSFC Engineering Consultant, Advanced Concepts Office**
leo.l.fabisinski@nasa.gov **Marshall Spaceflight Center, Huntsville, AL**
256-544-2385

Abstract:

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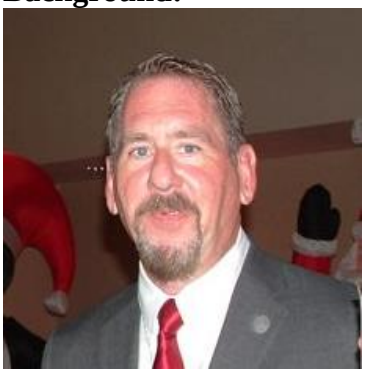
Background: **Please Fill in…….**



Wed, Dec 16th, PWS3C-4, 11:30am

"Instrumentation Overview of Space Environment Test Facilities at Plumbrook"

Richard Evans
richard.k.evans@nasa.gov
419-621-2238

Instrumentation Lead, Space Power Facility
NASA GRC/Plumbrook, Sandusky, OH
http://facilities.grc.nasa.gov/spf/index.html

Abstract:
Very large space environment test facilities present unique engineering challenges in the design of facility data systems. Data systems of this scale must be versatile enough to meet the wide range of data acquisition and measurement requirements from a diverse set of customers and test programs, but also must minimize design changes to maintain reliability and serviceability. This paper presents an overview of the common architecture and capabilities of the facility data acquisition systems available at two of the world's largest space environment test facilities located at the NASA Glenn Research Center's Plum Brook Station in Sandusky, Ohio; namely, the Space Propulsion Research Facility (commonly known as the B-2 facility) and the Space Power Facility (SPF). The common architecture of the data systems is presented along with details on system scalability and efficient measurement systems analysis and verification. The architecture highlights a modular design, which utilizes fully-remotely managed components, enabling the data systems to be highly configurable and support multiple test locations with a wide-range of measurement types and very large system channel counts.

Background:

Mr. Evans works in the Plum Brook Management Office of NASA Glenn Research Center's Plum Brook Station in Sandusky, Ohio. He is currently the lead Data Systems Engineer at the Space Power Facility. He has over fifteen years experience as a mixed-signal instrumentation and digital systems engineer, which includes over a decade of experience from the nuclear physics community having worked at the Thomas Jefferson National Accelerator Facility (TJNAF, formerly CEBAF) as a digital instrumentation engineer on the 1kW Demo Free Electron Laser and 10kW Free Electron Laser Projects. He holds a BS in Electrical Engineering from Geneva College (1995), and an MS in Applied Physics and Computer Science from Christopher Newport University (2006).

Wed, Dec 16th 12:30 – 3:00pm One-on-One Sessions

Purpose: Initiate relationships that may enable future wireless capability
Method: Users/Stakeholders have an assigned table to sit at
Less Wire Developers/Providers sign-up to meet with Users on an "as available" basis.
Scheduling: A spreadsheet for Tuesday slots will be made available at the registration desk to sign up on the User's schedule.
User and Developer/Provider must keep to the schedule
Moderator will announce the times to "move-on"

Tues PM	5:10-5:20	5:20-5:30	5:30-5:40	5:40-5:50	5:50-6:00
Wed PM	12:30/Lunch	12:45-1:00	1:00-1:15	1:15-1:30	1:30-1:45
	(User choice)				
Wed PM	1:45/Break	2:00-2:15	2:15-2:30	2:30-2:45	2:45-3:00
	User choice				
	(User choice)				
Conference Ends at 3pm					