

ICIT 2023

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## ICIT 2023 Special Session Proposal

### Title of the Proposal:

**Smart Sensors/Actuators and IEEE 1451 Standards for SG/IoT/IIoT/CPS**

### Session Organizers:

Organizer 1: Allen C. Chen ([c.j.chen@ieee.org](mailto:c.j.chen@ieee.org))

Affiliation: Innovatech Solutions, USA

Organizer 2: Eugene Song ([eugene.song@nist.gov](mailto:eugene.song@nist.gov))

Affiliation: National Institute of Standards and Technology (NIST), USA

Organizer 3: Kang Lee ([kang.lee@nist.gov](mailto:kang.lee@nist.gov))

Affiliation: National Institute of Standards and Technology (NIST), USA

Organizer 4: Victor Huang ([v.huang@ieee.org](mailto:v.huang@ieee.org)),

Affiliation: Sage Technologies, United States

### Technical Outline of the Session and Topics:

#### Outline of the Session

Sensors/actuators are used everywhere, such as in aerospace, automobile, environmental monitoring, asset tracking in supply chain, smart buildings/homes, healthcare, industrial automation, smart manufacturing (SM), smart grid (SG), Internet of things (IoT), industrial Internet of things (IIoT), cyber-physical systems (CPS), and smart cities. A smart sensor (SS) consists of a set of sensors and/or actuators with meta data and some capabilities such as signal conditioning, analog-to-digital conversion, digital-to-analog conversion, sensor data processing, timing and synchronization by an internal clock with optional external time reference, and network communications. Thus, SSs can have intelligent capabilities, such as self-description, self-identification, self-diagnostics, self-calibration, self-testing, self-validation, location-awareness, multi-

sensing and actuation, and data fusion. Hence, SSs can play key roles in SG/IoT/IIoT/CPS and smart city applications. SSs can provide data and status of SG/IoT/IIoT/CPS and smart city systems for real-time monitoring and control operations to improve overall system efficiency, performance, and reliability. However, sensor data exchange and interoperability are major challenges for all these applications. Standardizing smart sensor interfaces, for example, IEEE 1451 suite of standards, will help to achieve sensor data interoperability. Interoperability testing and measurement and assessment methods of smart sensors are keys to the success of achieving and assuring interoperability of smart sensors/actuators deployed in SG/IoT/IIoT/CPS and smart city systems.

### **Topics of the Session:**

This special session aims to provide a forum for discussion that will attract scholars and industry practitioners for sharing and discussing the latest advances in this scientific field. Topics in this session include, but are not limited to:

- Smart sensors/actuators
- Smart sensor digital twins
- IEEE 1451-based smart sensor/actuator interface standards and reference implementations
- IEEE 1451-based smart sensor/actuator interoperability and conformance testing methods and certifications
- Smart sensors for SG applications
- Smart sensors/actuators for IIoT/IoT applications
- Smart sensors/actuators for Cyber-physical systems
- Wireless sensor networks for industrial applications
- Security for smart sensors/actuators
- Timing and synchronization for smart sensors/actuators
- New sensor/actuator technologies for Industry 4.0

### **IEEE IES Technical Committee Sponsoring the Special Session (if any):**

IEEE IES Standards Technical Committee

### **Brief CV of the Special Session Organizers:**

#### **Allen C. Chen:**

Dr. Allen C. Chen has over 30 years of technical and managerial experience in computer, VLSI, and wireless communication industries. He was a lead engineer in developing mini-computer processors for NCR and Perkin Elmer. He then joined AT&T Bell Labs (then Lucent Technologies) where he contributed to developments of BELLMAC VLSI family and Wireless Base Stations technically and managerially. Allen then joined a startup company in Silicon Valley, CA where he managed the development of consumer products and embedded systems. Allen then served as VP of Engineering for Teleion Wireless where he spearheaded development of wireless data modules for smart phones. Presently he continues to consult in the field of wireless communications at Innovatech Solutions. Allen is an IES Life AdCom Member, IEEE Life Senior Member and Chair of IES Standards Technical Committee. He has served for IES in various capacity including General Chair, Program Chair, Track Chair, and Session Chair for many IES

conferences and IES Treasurer. He was a recipient of an IEEE Third Millennium Medal Award and IES Anthony Homfeck Award , IEEE SA Medallion Award, and was Chinese Institute of Engineers-USA National Council Chair. He holds a MS in ECE from University of North Dakota and Ph.D. in ECE from University of Wisconsin, Madison and is a Professional Engineer.

**Eugene Song:**

Dr. Eugene Song is an Electronics Engineer in Smart Grid (SG) Group, Smart Connected System (SCS) Division of Communications Technology Laboratory (CTL), National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA. His current research interests include smart sensors, IEEE 1451 interface standards, smart sensor interoperability, interoperability modelling, testing, and measurement and assessment methods, wide-area monitoring and control for SG, harmonics measurement, harmonics spectrum and distortion analysis of non-linear loads in distribution grids at the NIST SG and CPS test bed. Dr. Song is members of IEEE Industrial Electronics Society (IES), Power Electrical Society (PES), and Instrumentation and Measurement (IM) societies. Dr. Song is the chair of IEEE P1451.0 WG.

**Kang Lee:**

Kang Lee is an IEEE Life Fellow and retiree of the National Institute of Standards and Technology (NIST) with forty years of technical and management experiences in precision instrumentation and measurements, flexible and robotic manufacturing, smart and wireless sensor/actuator networks, and precision time synchronization of networked systems. Kang currently works on wireless systems for factory automation and smart sensor measurements and standards for smart grids. Kang is chairman of IEEE I&M Society's Technical Committee TC-9 on Sensor Technology coordinating the development of a suite of fourteen IEEE 1451 smart transducer interface standards for wired and wireless sensor networks, and the IEEE 1588 / IEC 61588 standard that is recognized worldwide as the Precision Time Protocol (PTP) standard, adopted for uses across industries, such as industrial automation, telecommunication, Smart Grid, and financial transactions. Kang has given invited keynotes on smart sensors, sensors and radio frequency identification (RFID), Internet of Things (IoT), and precision time protocol (PTP), etc. In 2014 Kang co-chaired an IEC study group and workshop at NIST and developed a white paper, *Internet of Things: Wireless Sensor Networks*. In 2006 Electronic Engineering Times profiled Kang in its *Great Minds and Great Ideas* project as one of twenty-nine innovators in the world.

**Victor Huang:**

Dr. Victor Huang is a senior level executive seasoned in high technology industrial management, having served as VP Engineering in 5 separate startups in Silicon Valley, as Deputy Director of the Institute of Microelectronics (IME) in Singapore's highly successful high technology industry, and Technical Manager at AT&T Bell Laboratories. His experience spans the telecommunications industry and electronic mobility, wireless, and consumer products, and VLSI microprocessor chip design. Dr. Huang is an IEEE Life Senior member, Life AdCom member of the IEEE Industrial Electronics Society (IES), IES Technical Committee Chair of Standards, IES representative to the IEEE Standards Board, Secretary and Member of the IEEE Technical Engineering Management Society (TEMS), Member of the IEEE Communications Society, and the TEMS representative to the IEEE Future Directions Initiative on Symbiotic Autonomous Systems.