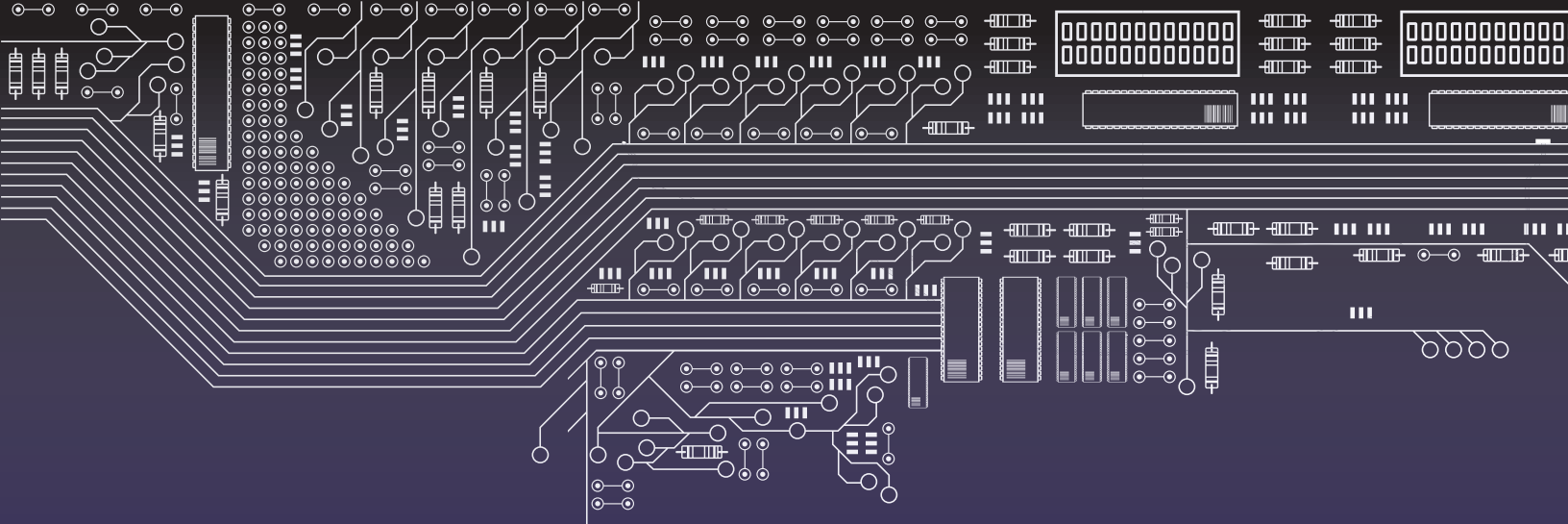


2014

UNIVERSITY OF PENNSYLVANIA

PRECISE

Cyber-Physical Systems Industry Day

Philadelphia, Pennsylvania
Thursday, October 9th

WELCOME

ALICE	Dmitry Koltunov
BuLogics, Inc.	Far McKon
BuLogics, Inc.	Gabe Torres
CIMIT/Massachusetts General Hospital/Partners HealthCare	Julian M. Goldman
Ciright Systems, LLC	Neel Shah
Comcast Cable	Weidong Mao
Covance	Dimitris Agrafiotis
Covance	Eric Yang
Ford Motor Company	Dona Burkard
General Electric	Amine Chigani
General Electric	Joseph J Salvo
General Motors Company	Tom Fuhrman
General Motors Company	Ramesh S
Hospira, Inc.	Michael Kremliovsky
MIT Lincoln Laboratory	James Won
NASA	Natasha Neogi
National Institute of Standards and Technology	Sokwoo Rhee
National Instruments	Jeannie Falcon
National Science Foundation	Keith Marzullo
National Science Foundation	Gurdip Singh
National Science Foundation [Former Program Director, CPS]	Helen Gill
Quad Fore LLC	Richard Goelz
Real Time Innovations Inc.	Mark Hamilton
Robert Bosch GmbH	Arne Hamann
Silicon Labs	Vignesh Subramanian
The White House	Richard Voyles
Toyota InfoTechnology Center	Shin'ichi Shiraishi
Toyota Motor Corporation	Jyo Deshmukh
Toyota Motor Corporation	Jim Kapinski
Toyota Motor Corporation	Xiaoqing Jin

PRECISE

PENN RESEARCH IN EMBEDDED COMPUTING AND INTEGRATED SYSTEMS ENGINEERING

PRECISE's "Cyber-Physical Systems Industry Day" is an informal and intimate day-long symposium for leading executives and engineers involved in designing and developing cyber-physical systems, embedded systems, hybrid and control systems, and Internet of Things.

GOALS

- Act as a launch pad for conversations to tackle increasing technical challenges resulting from the rapidly growing demand for new capabilities and applications with regards to the smart grid, next-generation air transportation system, intelligent transportation systems, smart medical technologies, smart buildings and smart manufacturing
- Showcase PRECISE's research on real-time systems, control design, sensing, security and applications
- Facilitate the exploration of funding opportunities for private companies, public institutions and other research-based organizations devoted to the development of Cyber-Physical Systems
- Develop an infrastructure for industry to connect with PRECISE to mutually benefit each other to address current and future trends
- Explore the potential for joint technical articles
- Explore the creation of testing and validation tools for distribution to industry

AGENDA

8:15 am - 9 am — **BREAKFAST & CHECK-IN**

9 am - 9:15 am — **WELCOME**

Kathleen Stebe, *Penn Engineering - Welcome*

Insup Lee, *Penn Engineering - Welcome*

Keith Marzullo, *National Science Foundation - "Cyber-Physical Systems: Internet of Things and Much More"*

9:15 am - 9:45 am — **MORNING KEYNOTE**

Joseph J Salvo, *General Electric - "The Industrial Internet and the Digital Thread in the Systems Age"*

9:45 am - 10:05 am — **THEME 1: MEDICAL DEVICES & HEALTHCARE**

Julian M. Goldman, *CIMIT/Massachusettes General Hospital - "Medical Device Plug-and-Play (MD PnP) Interoperability"*

Michael Kremliovsky, *Hospira - "Mixing Cyber and Physical in Medical Devices"*

10:05 am - 11 am — **THEME 2: TRANSPORTATION**

Dona Burkard, *Ford Motor Company - "Multi-Core in Vehicle Applications"*

Tom Fuhrman, *General Motors Company - "Automotive CPS Architecture Trends and Challenges"*

Natasha Neogi, *NASA - "Cyberphysical Concerns in the Next Generation Air Transportation System (NextGEN)"*

Arne Hamann, *Robert Bosch GmbH - "Formal Analysis of Timing Effects on Closed-Loop Properties of Embedded Control Software"*

Shin'ichi Shiraishi, *Toyota InfoTechnology Center - "Making Autonomous Driving Safe: Formal Analysis of Driving Scenarios"*

AGENDA

11 am - 11:15 am — **BREAK**

11:15 am - 12:30 pm — **2-MINUTE MADNESS**

12:30 pm - 2 pm — **POSTER + DEMO LUNCH**

2 pm - 2:30 pm — **AFTERNOON KEYNOTE**

Jeannie Falcon, *National Instruments - "A Unified Yet Open Software & Hardware Architecture for Cyber-Physical Systems"*

2:30 pm - 3:20 pm — **THEME 3: INTERNET OF THINGS**

Gabe Torres (with Far McKon), *BuLogics, Inc. - "Internet of (Mostly Working) Things: Challenges in Smart Building Deployment"*

Amine Chigani, *General Electric - "Architecting in the Age of the Industrial Internet"*

Sokwoo Rhee, *National Institute of Standards and Technology - "Internet of Things and Cyber-Physical Systems for Smart Cities"*

Mark Hamilton, *Real Time Innovations Inc. -"What's the Right Protocol for the Industrial Internet of Things?"*

3:20 pm - 3:35 pm — **BREAK**

3:35 pm - 4:15 pm — **FOSTERING COLLABORATIONS, TECHNOLOGY TRANSFER & CLOSING REMARKS**

Richard Voyles, *Office of Science and Technology Policy (The White House) - "Productive: Another 'P' for the Public/Private Partnership"*

Trude Amick (with Laurie Actman), *Penn Center for Innovation - "Technology Transfer & Success Stories"*

Insup Lee, *Penn Engineering - "Closing Remarks"*

4:15 pm - 5:30 pm — **RECEPTION**

KEYNOTE SPEAKERS

Joseph J Salvo

General Electric

Director and Founder

Dr. Salvo is the Director and Founder of the Industrial Internet Consortium with an aim to connect brilliant minds and machines in powerful value creation networks. For the past 15 years he and his laboratory have developed a series of large-scale internet-based sensing arrays to manage and oversee business systems and deliver a portfolio of information-based services.

Some of their commercial business releases include complex decision platforms (e.g. GE Veriwise™ GE RailwiseTM, Global Vendor Managed Inventory, Ener.GE™, and E-Materials Management) that deliver near real-time customer value through system transparency and knowledge-based computational algorithms.

Pervasive networked sensors systems combined with near-real time collaboration can deliver time-critical, high fidelity data to enable information analysis across traditional business process boundaries. Total supply chain, digital manufacturing, energy management and financial services can be integrated to create a virtual enterprise environment that encourages discovery and process improvement on a global basis. Electronic RFID tagging and distributed knowledge networks extend the reach of these systems with anywhere/anytime access to mission critical information.

Dr. Salvo's group will be providing the core Digital Market Commons to UI Labs for the recently announced Digital Design Manufacturing Innovation Institute in Chicago. Crowdsourcing and cloud computing platforms promise to further democratize the flow of information, computation and ideas. Commercial business implementations of this work are currently active in Asia, Europe as well as North and South America.

Jeannie Falcon

National Instruments

Chief Product Manager

Dr. Jeannie Sullivan Falcon is the chief engineer for control and mechatronics at National Instruments. She leads product strategy and technical marketing efforts in the use of LabVIEW for design. This includes real-time math, analysis, signal processing, control design, and simulation. Dr. Falcon joined NI in 2000 as the group manager for motion control in R&D and has also served as a hardware product strategist. She has also led research in control and mechatronics at the Air Force Research Laboratory and Midé Technology Corporation. Her team at AFRL won an SPIE "Smart Structures Product Implementation Award" for their work on the Vibration Isolation and Suppression System – a precision pointing system for optical payloads on satellites. In addition to her work at NI, she is a lecturer at the University of Texas at Austin in both the mechanical engineering and aerospace engineering departments. She received her bachelor's degree in physics from Carnegie Mellon University and holds her master's and doctoral degrees in mechanical engineering from the Massachusetts Institute of Technology.

INVITED SPEAKERS

Dona Burkard

Ford Motor Company
Software Engineering & Implementation Supervisor

Dona Burkard has worked in the automotive industry for over 20 years. Her current position at Ford Motor Company has her focusing on the advancements of the microcontroller industry for powertrain applications. The research is performed at Ford's Research and Innovation Center located in Dearborn Michigan. Dona received her BE in Computer Engineering and MS in Engineering Management from Oakland University, Michigan. Dona's experience embraces many facets of the automotive industry. Her technical experience includes advanced research in: automotive electrical architectures, powertrain controls, global manufacturing real-time systems, powertrain diagnostic systems, alternative propulsion, and start-up engine software. She is currently a member of the Electrical and Computer Engineering Industrial Advisory Board at Oakland University.

Amine Chigani

General Electric
Industrial Internet Architect

Dr. Amine Chigani is an Industrial Internet Architect at GE Software Center of Excellence. His work focuses on building solution and enterprise architectures for Industrial Internet domains including transportation, aviation, energy, and healthcare. He is a founding member and contributor within the Industrial Internet Consortium. Prior to his current assignment, Dr. Chigani was a Architecture Research Scientist at GE Global Research where he was key to developing GE's open collaboration, crowd driven engineering design platform to help engineers collaborate on designing products, sharing analysis models, and interacting with data. Before joining GE, Dr. Chigani was a Visiting Scientist at Carnegie Mellon's Software Engineering Institute where he helped the Department of Homeland Security and FEMA develop integration strategies to guide the adoption of the Wireless Emergency Alert System by emergency alert originators nationwide. Dr. Chigani has publications in the International Journal of System of Systems Engineering, IEEE Software Engineering Workshop, Software Architecture User Network Conference, IEEE Conference on Software Engineering Education and Training, and International Conference on Software Reuse. He is a program committee member in several software architecture conferences. He holds a BS in Computer Science from Radford University, and MS and PhD in Computer Science from Virginia Tech. He also holds the Software Architecture Professional Certificate from the SEI.

Tom Fuhrman

General Motors Company
Technical Fellow

Tom Fuhrman is a Technical Fellow at General Motors R&D in the Electrical & Control Systems Research Lab. He has contributed to automotive R&D for 34 years, including 2 years at Chrysler and 32 years at General Motors. Contributions include behavioral synthesis of very large scale integrated circuits, executable specification modeling of vehicle features and functions, formal methods analysis for safety properties, embedded software architecture, vehicle electrical architecture, vehicle safety and fault-tolerant architecture, and software fault tolerant architecture. Tom holds a Master's Degree in Electrical and Computer Engineering from the University of Michigan.

INVITED SPEAKERS

Julian M. Goldman

CIMIT/Massachusettes General Hospital
Medical Director/Anesthesiologist

Julian M. Goldman, MD is an anesthesiologist at the Massachusetts General Hospital, Medical Director of Biomedical Engineering for Partners HealthCare, and the Director/PI of the Program on Medical Device Interoperability "MD PnP"- a multi-institutional federally funded program established in 2004 to advance safe medical device interoperability to improve patient safety and HIT innovation (see www.mdpnp.org)

Dr. Goldman completed his anesthesiology residency and medical device informatics fellowship at the University of Colorado, and served as a Visiting Scholar in the FDA Medical Device Fellowship Program as well as an executive of a pulse oximetry company. At MGH, he served as a founding anesthesiologist of the "OR of the Future." Dr. Goldman Chairs the international standardization committee for the safety and performance of anesthesia and respiratory equipment (ISO TC 121), and ASTM Committee F29.21 on Devices in the Integrated Clinical Environment (ICE). His awards include the AAMI Foundation/Institute for Technology in Health Care Clinical Application Award, the International Council on Systems Engineering Pioneer Award, and the American College of Clinical Engineering award for Professional Achievement in Technology.
E-card: www.jgoldman.info

Arne Hamann

Robert Bosch GmbH
Senior Expert

Arne Hamann obtained his PhD in Computer Science in 2008 from the Technical University of Braunschweig, Germany. His PhD thesis was awarded the EDAA Outstanding Dissertation Award 2009 in the category "New directions in embedded system design and embedded software". Currently, Arne Hamann is working for Bosch Corporate Research in the division of "Software-intensive Systems". There, he acts as senior expert for real-time system design principles for physically dominated embedded systems. Additionally, he is in charge of an internal research project introducing novel model-centric system design methods into various business units within the Bosch Group. Arne Hamann is part of the AUTOSAR Timing Extensions Subgroup as well as the AUTOSAR Timing User Group. Additionally, he represents Bosch in the European ROS Industrial Consortium (RIC-EU). In the academic context, he currently serves as industrial advisory board member of the European COST action TACLe (Timing Analysis on Code Level) and program committee member of the EMSOFT and ECRTS conferences.

INVITED SPEAKERS

Mark Hamilton

Real Time Innovations Inc.
VP of Services

Mark graduated with a BSEE degree from Virginia Tech, Magna Cum Laude, and an MSEE from Johns Hopkins University. He joined RTI in 2003 and led the consulting services team for the past 3 years. He brings to RTI over 27 years of experience in technical and customer-facing leadership roles. His previous experience includes positions at companies such as the Applied Physics Laboratory and Wind River Systems. He served as a Field Applications Engineer, designed embedded real-time systems, and was employed at the Johns Hopkins University/Applied Physics Laboratory as a design engineer developing intelligence gathering systems, as well as developing high-performance embedded software for various Navy programs including the Cooperative Engagement Capability (CEC) and Ship Self-Defense System (SSDS).

Michael Kremliovsky

Hospira
Lead Systems Architect

Michael Kremliovsky, PhD, is a Lead Systems Architect at Hospira, Inc. Prior to this, he was the Senior Principal Scientist in Medtronic Diabetes. Previously, Dr. Kremliovsky was a Senior Principal Scientist at CardioNet, Inc. in California. He specializes in R&D-heavy product development, medical devices, novel and traditional signal processing, detection and classification of signals and systems, BigData architecture for mission-critical applications in healthcare, machine intelligence, software development methodologies, business automation. Dr. Kremliovsky completed postdoctoral research in signal processing and nonlinear dynamical systems in University of California at San Diego. Among Michael's career achievements are: new class of nonlinear signal processing algorithms (Delayed Differential Analysis), first web-based HIPAA-compliant doctor-patient communication framework, first mobile (wireless cell) cardiac monitor, and first fully autonomous closed-loop glucose control (artificial pancreas) device.

INVITED SPEAKERS

Keith Marzullo

National Science Foundation
Division Director

Keith Marzullo is the Division Director for the Computer and Network Systems (CNS) Division in the Computer and Information Science and Engineering (CISE) Directorate at the National Science Foundation. He was at NSF on leave from the Computer Science and Engineering Department at the University of California, San Diego, but converted to a Federal employee in 2014. He has been on the UCSD faculty since 1993. He received his Ph.D. in Electrical Engineering from Stanford University in 1984; for his Ph.D. he developed the Xerox Research Internet Clock Synchronization protocol, which was one of the first practical fault-tolerant protocols that kepts widely-distributed clocks synchronized with each other. In 1986, he left Xerox and joined the CS Department at Cornell University where with colleagues Ken Birman and Robert Cooper, he started the company ISIS Distributed Systems, which provided middleware for fault tolerant distributed applications; this software was used by financial and investment institutions. He served as a Professor at Large in the Computer Science Department at the University of Tromso from 1999-2003, was Chair of ACM SIGOPS from 2003-2007, and Chair of the CSE Department from 2006-2010. His current research focuses on issues in distributed systems and security. He is a Fellow of the ACM.

Far McKon

BuLogics, Inc.
CTO

Far McKon, one of Philadelphia's great community creators and extraordinary innovators is responsible for driving the quality and accessibility of BuLogics' products and services to the next level. Far joins BuLogics from MakerBot's Industries, where he was architect and project lead for their software department. During his tenure, MakerBot released such groundbreaking products as The Replicator, The Replicator 2/2X, and MakerWare desktop suite; a cross-platform and consumer-friendly desktop 3D print suite.

Natasha Neogi

NASA
Research Aerospace Technologist

Natasha Neogi is currently at the NASA Langley Research Center's Safety Critical Avionics System Branch. She received her B.Eng.Hons in Mechanical Engineering from McGill University, her M.Phil in Physics from Cambridge University, and her Ph.D in Aeronautical and Astronautical Engineering from MIT. She attained her private pilot's license while she was an assistant professor in the Department of Aerospace Engineering at the University of Illinois, Urbana-Champaign. There, she headed the Aerospace Laboratory for Embedded Autonomous Systems (ALEAS), where she coordinated a multi-vehicle flight demonstration of an autonomous mixed air-ground mobile network in collaboration with the Boeing Corporation, under funding from the Office of Naval Research. Her current research interests include the verification and validation of safety-critical cyberphysical systems, as well as the fault tolerance of distributed autonomous systems. Her recent projects include studies into the validation of distributed air traffic management concepts and avionics systems, as well as exploration of relevant issues in the certification of uninhabited aerial systems for use in the National Airspace System. She was the recipient of the AIAA Robert A. Mitcheltree Young Engineer Award and the IEEE-INCOSE Peninsula Council Doug Ensor Young Engineer Award in 2012.

INVITED SPEAKERS

Sokwoo Rhee
National Institute of Standards and Technology
Associate Director

Dr. Sokwoo Rhee is Associate Director of Internet of Things and Cyber-Physical Systems at National Institute of Standards and Technology. He served as a Presidential Innovation Fellow on Cyber-Physical Systems and co-lead the SmartAmerica Challenge, which brought together Internet of Things technologies and Cyber-Physical Systems across the nation to demonstrate how IoT/CPS can boost American competitiveness and provide concrete examples of the socio-economic benefits. Prior to joining US government, he was Co-founder and CTO of Millennial Net, Inc., which was one of the first to successfully commercialize low-power wireless mesh/sensor network and Internet of Things technology from academia. Prior to the founding of Millennial Net, he worked on wireless medical sensors as a research associate at Massachusetts Institute of Technology. His work and achievements have been recognized through awards including MIT Technology Review's Top Innovators under 35. He received his M.S. and Ph.D. in Mechanical Engineering from Massachusetts Institute of Technology.

Shin'ichi Shiraishi
Toyota InfoTechnology Center
Senior Researcher

Shin'ichi Shiraishi received his B.S., M.S., and Ph.D. degrees in Electronics Engineering from Hokkaido University, Japan, in 1997, 1999, and 2002, respectively. He is currently a Senior Researcher at Toyota InfoTechnology Center, U.S.A. Inc. His research interests include software assurance, software architecture, and modeling languages. He is a member of the IEEE.

INVITED SPEAKERS

Gabe Torres

BuLogics, Inc.
CTO

Gabe Torres is the CTO and technology visionary of BuLogics, Inc. Torres joined BuLogics in 2011 after attending the University of Pennsylvania and works tirelessly to improve the quality and technical vision at BuLogics. Torres pioneers high-level software engineering practices in the embedded wireless space, resulting in rapid development cycles and groundbreaking products. Torres envisioned and created accessible code libraries enabling completion of products from conception to shelf in mere months, while comparable projects require as many as two years. These libraries answer the call for the most complex hardware and software specifications in the wireless engineering field, with unparalleled battery life and security protocol advances beyond any to date, thereby improving the products incomparably and reducing time to market and money significantly. Taking advantage of his unique expertise integrating software and hardware, Torres leads the BuLogics' Engineering Team to create the most sophisticated wireless systems in the industry, while exploring cutting edge product ideas and methodologies for the Internet of Things.

Richard Voyles

Office of Science and Technology Policy (The White House)
Assistant Director of Robotics and Cyber-Physical Systems

Dr. Voyles has been a researcher, deployer, and advocate for robotics and cyber-physical systems most of his academic and professional life. He is currently the Associate Dean for Research in the College of Technology at Purdue University as well as the founding director of the Purdue Robotics Accelerator. Recently, he was concurrently serving the Office of Science and Technology Policy at the White House as Assistant Director of Robotics and Cyber-Physical Systems. In this role, he was instrumental in the expansion of the DARPA Robotics Challenge as an international cooperation, advocated for increased funding for robotics and CPS research, and pushed for "filling the gaps" in the educational continuum "from HS to MS," including Engineering Technology. Prior to this appointment, he was lead Program Director at the National Science Foundation running the National Robotics Initiative and was one of the founding PDs of the Innovation Corps program.

Prof. Voyles' formal training includes the pillars of robotics – electrical, mechanical and computer engineering -- having received the B.S. in Electrical Engineering from Purdue University in 1983, the M.S. in Manufacturing Systems Engineering from the Department of Mechanical Engineering at Stanford University in 1989, and the Ph.D. in Robotics from the School of Computer Science at Carnegie Mellon University in 1997. He has been Associate Professor of Computer Science at the University of Minnesota and Associate Professor of Electrical and Computer Engineering at the University of Denver as well as Site Director of the NSF Safety, Security, and Rescue Research Center, an NSF Industry/University Cooperative Research Center. Dr. Voyles' research interests are in the areas of robotics and artificial intelligence. Specifically, he is interested in the development of small, resource-constrained robots and robot teams for urban search and rescue and surveillance as well as new generations of materials and co-robots for intelligent, human-assistive tasks. Dr. Voyles has additional expertise in sensors and sensor calibration, particularly haptic and force sensors, and real-time control. Dr. Voyles' industrial experience includes Dart Controls, IBM Corp., Integrated Systems, Inc., Avanti Optics and Mark V Automation Corp. He has also served on the boards of various start-ups and non-profit groups.

POSTER SESSION

ENERGY-EFFICIENT BUILDING CONTROLS

Madhur Behl, *Model-IQ - Low-cost Building Model Capture for Energy-Efficient Controls, MLE+ Integrated Toolbox for Energy-efficient Building Modeling and Control*

FOUNDATIONS OF CPS

Nicola Bezzo, *Programming and Design Environments for Robotic Applications*
Lu Feng, *Platform-Specific Timing Verification Framework in Model-Based Implementation*
Jie Fu, *Synthesizing Shared Autonomy Policies with Temporal Logic Constraints*
Salar Moarref, *Compositional and Hierarchical Synthesis of Reactive Controllers for Multi-Agent Systems*
Junkil David Park & Wenrui Meng, *Synthesis of Platform-Aware Controller Code*
Mukund Raghothaman, *DReX: A Declarative Language for Regular String Transformations*
Indranil Saha, *Compositional Synthesis of Multi-Robot Motion Plan via SMT Solving*
Abhishek Udupa, *Synthesis of Distributed Protocols from Scenarios and Requirements*
Shaohui (Vincent) Wang, *Causality Analysis in Component-based Systems*
Meng Xu, *From Compositional Scheduling to Real-Time Virtualization*

FOUNDATIONS OF CPS / SECURITY

Radoslav Ivanov, *Attack-Resilient Sensor Fusion for CPS*
Fei Miao, *Coding Sensor Outputs for Injection Attacks Detection*

FOUNDATIONS OF CPS / TRANSPORTATION

Miroslav Pajic, *Robust State Estimation in the Presence of Sensor and Actuator Attacks*

INTERNET OF THINGS

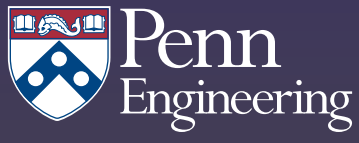
Kuk Jang, *xLAB: Experience Design & Technology for Internet of Things*
Andrew King, *MIDAS: Enabling Robust Real-Time Publish / Subscribe in Open Systems with OpenFlow*
Cameron Nowzari, *Data-Driven Resource Allocation for Controlling Spreading Processes*

MEDICAL DEVICES & HEALTHCARE

Krithika Baskaran, *Safety-Assured Model-Based Implementation for GPCA Infusion Pump Software*
Liang Cheng, *A Security Architecture for Integrated Clinical Environment Systems*
Hyon Young Choi, *Quantum Communication API (QC-API) and Open Health Connector (OHC) for Portable Plug and Play Medical Applications*
Zhihao "Hao" Jiang, *Closing the Loop with Medical Cyber-Physical Systems*
Alex Roederer, *Creating Smarter Alarms: Physiologic Data and Clinical Decision Support*
James Weimer & Radoslav Ivanov, *Early Detection of Neonate Hypoxia Caused by Pulmonary Shunt*

TRANSPORTATION

Sanjian Chen, *Model-Based Safety Analysis of Human-Supervised Multi-Feature Cyber-Physical Systems*
Fei Miao, *Real-Time Taxi Dispatch with Model Predictive Control*
Matthew O'Kelly, *APEX: Autonomous Vehicle Plan Verification and Execution*
Yash Pant, *Lean Control for Peak Power Minimization in Hybrid Electric Vehicles*


Penn
Engineering