Sushanta Mohan Rakshit

Driving innovation and solution through research in wireless communications and embedded systems with a combined experience of 11 years 1969 Trento Loop, Milpitas, CA. USA. | Email: sm.rakshit@gmail.com Phone: +1-402-595-0676 https://www.linkedin.com/in/sushantamohanrakshit

Education

University of Nebraska-Lincoln

Ph.D in Computer Engineering M.S. in Telecommunications Engineering | Current GPA: 3.896| Graduation: May, 2019| GPA: 4.0| Graduation: 2013

Industry Experience

Robert Bosch LLC, Research and Technology Center, Sunnyvale, CA

Lead Wireless Research Engineer Senior Wireless Research Engineer Wireless Research Engineer 2 Wireless Research Engineer July 2024 – Current January 2020 – June 2024 July 2018 – Dec 2019 October 2017 – June 2018

Perfectly Keyless

- Developed novel localization algorithms and protocols over Ultra-wideband (UWB) radio communication technology (IEEE 802.15.4z).
- Developed proof-of-concept system involving both embedded hardware and software.
- Developed Perfectly Keyless Localization and Optimization Tool (PLOT) as a digital twin for UWB on-car system.
- Reduces system development, test and integration cycle times by more than 85%.
- System implementation, deployment, test, and optimization leading to Consumer Electronics Show (CES) 2019 Honoree List for automotive use-case project using the proof-of-concept system.
- Development of innovative protocol and algorithm solutions for iterative improvement of UWB localization system performance.
- Presently developing novel signal processing and machine learning techniques for sensing applications such as intrusion and presence detection in automotive and residential markets.

Connected Sensors

- Development of novel time-keeping mechanisms over BLE (Bluetooth Low Energy) for low-power personal area networks.
- Achieved time synchronization performance of ~1ms (>95% improvement) from current stateof-art.
- Technology demonstrated successfully at CES 2024.

<u>Combined business impact of Perfectly Keyless and Connected Sensors exceeds €800M by</u> 2030.

NASA Tipping Point

- Design and development of autonomous fiducial-driven navigation algorithm for lunar rover.
- Design and development of auto exposure algorithm for rover camera for extreme incident light intensity variations.
- Impact on \$1.02M grant for Bosch in collaboration with WiBotic (https://www.wibotic.com/) and Astrobotic (https://www.astrobotic.com/) as part of NASA Tipping Point contract # 80LARC21C0013 (Ultra-Fast Proximity Charging for Critical Space Applications). Duration:

July 2021 – December 2024.

Industry 4.0

- Development of low-power wireless networking system involving algorithm, hardware and software for industrial monitoring.
- Developed custom filtering algorithms leading to >90% stabilization of localization system performance in presence of severe metallic interference to radio frequency signals.
- System deployed in 5 plants (4 in China; 1 in Hungary).

Building Technology

- Developed low-power video transmission protocol over 2.4GHz wireless communication technology for motion detectors.
- Conceptualized and implemented modular architecture.
- Realized unique selling point of minimizing development effort needed for future iterations involving new radios and sensors.

Other Contributions

- Setup of motion capture system for high-fidelity tracking of tagged objects.
- Rapid prototyping using off-the-shelf and custom hardware for proof-of-concept development.
- Involved in tracking developments in wireless networking standards including IEEE 802.15.4 (like Ultra-wideband), IEEE 802.11 (Wi-Fi), BLE (Bluetooth Low Energy) and Matter.
- Establishing research innovation pipeline via scouting new wireless technology landscape in academia and industry.
- Affected administrative improvement in employee experience via Impulse Network membership leading to improvements in immigration process flow and employee on-boarding.

Recognition and Publication

- Performance recognition award 2018, 2019 from Robert Bosch LLC.
- Published 4 patents in multiple geographies, 7 patents currently under review by the patent office, 3 patents under preparation and 1 paper (secured best runner up at SECON 2020).

Selected Academic Project Experience

FRA WSN HTNMote Hardware Development

- Performed end-to-end design, development and validation of a wireless sensor network hardware platform named HTNMote for the Federal Railroad Administration as part of a \$750,000.00 project.
- Handled full development life cycle from requirements gathering, schematic design, PCB layout, routing and optimization, post-fabrication hardware debugging. Worked with ARM Cortex-M microcontroller, Wi-Fi, Bluetooth (Legacy and BLE), ZigBee protocols, USB, Cadence Allegro Suite

16.5 and 16.6, logic analyzers, oscilloscopes, vector signal analyzer and channel emulator.

- Designed firmware for distributed sensing and control using the hardware platform using wireless multi-hop multi-standard communication in energy constrained environment of the freight railroad. System wholly written in embedded C/C++ with interrupt driven low response delay design.
- Performed successful field test with the hardware on a 36-rail car train deployment at the Transportation Technology Center Inc. under the Association of American Railroads at Pueblo in Colorado.
- System resulted in 140% better performance over commercial solutions.
- Student Travel Award. Federal Railroad Administration, US Department of Transportation. 2012 and 2014.

April 2011 – September 2015

Development of Energy Model for Hybrid Technology Networking

August 2015 -September 2017

January 2014 - August 2015

- Developing a mathematical model for scalable wireless sensor network energy demand prediction.
- Modular in nature allowing plug-and-play capability for varied network deployments and flavors.

HTNMote miniaturization

- Optimized design and layout to reduce HTNMote board size by over 60%.
- Hardware components and firmware optimizations done to reduce energy consumption by 15%.

Hybrid Technology Networking (HTN) Protocol Development January 2012 - December 2014

Developed a communication protocol suited to the environment of the railroads. Conceptualized, designed, validated, and optimized light-weight battery optimized message and protocol exchanges leading to 32% increase in communication efficacy over standard wireless networking protocols.

| SKIIIS | |
|-------------------------------------|---|
| Programming Languages: | C, C++, Embedded C (Proficient), Java (Familiar), Python |
| | (Regular use), MATLAB |
| Hardware Description Languages | s: VHDL, Verilog |
| Operating Systems: | Linux, Unix, Windows, MAC OSX. |
| Real-Time Operating Systems: | Contiki, FreeRTOS, TI-RTOS, TinyOS. |
| Hardware: | ARM microcontrollers, PIC, Atmel AVR., Freescale. |
| IDE: | IAR Workbench, Code Composer Studio, Freescale |
| | CodeWarrior, Eclipse. |
| Technologies/Standards: | UART, SPI, I2C, SDIO, JTAG, cJTAG, USB, IEEE |
| | 802.15.4, ZigBee, 6LowPAN, IEEE 802.11 (WiFi), Classic |
| | Bluetooth, BLE4.0, BLE5.0+, UWB, TCP/IP, UDP, GNU Radio, |
| | CAN, Modbus. |
| Tools: | Cadence Suite (OrCAD, PCB Editor, etc.) 16.5 and 16.6, |
| | Techtronix and Saleae logic analyzers, oscilloscopes, Agilent |
| | Vector Signal Analyzer, Azimuth channel emulator, Optitrack |
| | Motion Capture System. |

Patents

- Kubra Alemdar, Vivek Jain, Sushanta Mohan Rakshit, "Ultra-wideband device • fingerprinting", US20230379702A1. https://patents.google.com/patent/US20230379702A1/en
- Yunze Zeng, Avinash Kalyanaraman, Sushanta Mohan Rakshit, Vivek Jain, "Ultrawideband intelligent sensing system and method for car states detection", US11789135B2. https://patents.google.com/patent/US11789135B2/en
- Vivek Jain, Sushanta Mohan Rakshit, Yunze Zeng, "Ultra-wideband intelligent sensing system and method", US11402485B2. https://patents.google.com/patent/US11402485B2/en
- Vivek Jain, Sushanta Mohan Rakshit, Martin Coors, "Ultra-wideband based vehicle access system and communication protocol for localization of a target device", US10573104B2. https://patents.google.com/patent/US10573104B2/en
- Vivek Jain, Sushanta Mohan Rakshit, "Methods for robust ultra-wideband localization system", filed with US patent office.
- Vivek Jain, Kaustubh Gandhi, Sushanta Mohan Rakshit, Abhinav Kunchamwar, "System and method for body area network with transmit only devices", filed with US patent office.
- Vivek Jain, Kaustubh Gandhi, Sushanta Mohan Rakshit, Abhinav Kunchamwar, "System ٠

Chille

and method for body area network with bistatic wireless backscattering devices", *filed with US patent office*.

- Liu Ruofeng, Vivek Jain, Christoph Lang, Martin Coors, Sushanta Mohan Rakshit, Yunze Zeng, "Distributed sensing with ultra-wideband radios", *filed with US patent office*.
- Sandeep Baddam Reddy, Sirajum Munir, Jonathan Francis, Sushanta Mohan Rakshit, Martin Coors, Samarjit Das, Vivek Jain, "A system and method of fusing wireless and visual features for robust state estimation", *filed with US patent office*.
- Sandeep Baddam Reddy, Jonathan Francis, Sirajum Munir, Sushanta Mohan Rakshit, Martin Coors, Samarjit Das, Vivek Jain, "A system and method for optimal control of a mobile robot under sensor uncertainties", *filed with US patent office*.
- Sandeep Baddam Reddy, Jonathan Francis, Sirajum Munir, Sushanta Mohan Rakshit, Martin Coors, Samarjit Das, Vivek Jain, "A system and method for learning sensor measurement uncertainty", *filed with US patent office*.

Selected Publications Book Chapter

• S. Mohan Rakshit, Rezaei, F., Shrestha, P. Lal, Hempel, M., and Sharif, H., "*HTNMote: A Platform for on-board real-time monitoring of railcars*", in Technological Breakthroughs in Modern Wireless Sensor Applications, IGI Global, 2015, pp. 1 - 26.

Academic Publications

- Avinash Kalyanaraman, Y. Zeng, Rakshit Sushanta, and V. Jain, "*CaraoKey : Car States Sensing via the Ultra-Wideband Keyless Infrastructure*," Jun. 2020, doi: https://doi.org/10.1109/secon48991.2020.9158440. [Best paper runner-up SECON 2020]
- S.M. Rakshit, Banerjee, S., Hempel, M., Sharif, H., "*Fusion of VR and teleoperation for innovative near-presence laboratory experience in engineering education*", to be published in the Proceedings of IEEE International Conference on Electro Information Technology, May 14-17, 2017.
- S. M. Rakshit, M. Hempel and H. Sharif, "*A modular energy model for the low power radio domain in linear-topology hybrid technology network*", in ASME/ASCE/IEEE Joint Rail Conference, 2017.
- S. M. Rakshit, M. Hempel and H. Sharif, "*Wireless sensor networks in surface transportation*", 2016 10th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP), Prague, 2016, pp. 1-6.
- S. M. Rakshit, M. Hempel and H. Sharif, "*Study of a dual radio sensor platform for effective on-board real-time monitoring of freight trains*", 2016 International Wireless Communications and Mobile Computing Conference (IWCMC), Paphos, 2016, pp. 812-817.
- S.M. Rakshit, Hempel, M., Banerjee, S., Sharif, H., "*Towards A Modular IoT Network Model: Low Power Radio Domain Use-Case in Linear-Topology Wireless Sensor Network*", in 2016 International Conference on Selected Topics in Mobile and Wireless Networking, Cairo, Egypt.
- S. M. Rakshit, Hempel, M., Shrestha, P. L., Rezaei, F., Sharif, H., Punwani, J., and Stewart, M., "Energy Analysis in Deploying Wireless Sensor Networks for On-Board Real-Time Railcar Status Monitoring", in 2015 Joint Rail Conference, San Jose, California, USA, 2015.
- S. M. Rakshit, Hempel, M., Rezaei, F., Shrestha, P. L., and Sharif, H., "A Mathematical Model of Energy Consumption in Hybrid Technology Network", in International Conference on Signal Processing and Communication Systems (ICSPCS), 2015.
- S. M. Rakshit, Hempel, M., Shrestha, P. L., Rezaei, F., and Sharif, H., "*HTNMote: A Hardware Platform for the Implementation of the Hybrid Technology Networking protocol and its Performance Analysis*", in ASME/ASCE/IEEE Joint Rail Conference, 2014.
- S. M. Rakshit, Hempel, M., Sharif, H., Punwani, J., Stewart, M., and Mehrvarzi, S., "Challenges in current Wireless Sensor Technology for Railcar Status Monitoring for North America's Freight Railroad Industry", in ASME/ASCE/IEEE Joint Rail Conference, 2012,

pp. 1-9.

• S. M. Rakshit, Hempel, M., Sharif, H., Punwani, J., and Stewart, M., "Hybrid Technology Networking: A Novel Wireless Networking Approach for Real-Time Railcar Status Monitoring", in ASME Rail Transportation Division Fall Technical Conference, 2012, pp. 1-7.

Awards and Honors

- Best paper runner-up at SECON 2020.
- Automotive use-case project mentioned in CES 2019 Honoree List.
- Performance recognition award 2018 and 2019 from Robert Bosch LLC.
- IEEE Travel Grant. IEEE Conference on Communications and Network Security. Florence, Italy. 2015.
- Milton E. Mohr Fellowship. College of Engineering. April 2014.
- Student Travel Award. Federal Railroad Administration, US Department of Transportation. 2012 and 2014.
- Graduate Research & Teaching Assistantship (Full tuition waiver and stipend). Department of Electrical and Computer Engineering, University of Nebraska-Lincoln. 2011-Present.