

JUNSUNG KIM

CONTACT INFORMATION

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EDUCATION

Carnegie Mellon University, Pittsburgh, Pennsylvania, USA
Ph.D. Candidate in Electrical and Computer Engineering, 2014 (Expected)
Dissertation title: *Dependable Cyber-Physical Systems: a Software-based Approach*
Adviser: Prof. Raj Rajkumar

Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
M.S. in Electrical Engineering, August 2004
Dissertation title: *Energy-Aware Resource Allocation in WLAN Mobile Devices*
Adviser: Prof. Song Chong

Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
B.S. in Electrical Engineering, August 2002
Magna Cum Laude

RESEARCH INTERESTS

Cyber-Physical Systems, Embedded Real-Time Systems, Fault-Tolerant Computing, Autonomous Vehicles, Distributed Systems, Operating Systems, Wireless Networks, and Long Term Evolution.

HONORS AND AWARDS

Best Paper Nominee, in the ACM/IEEE 4th International Conference on Cyber-Physical Systems. (2013)
Second Prize, in the Hyundai Global Top Talent Forum. (2012)
Best Paper Nominee, in the ACM/IEEE 3rd International Conference on Cyber-Physical Systems. (2012)
Best Paper Award, in the 4th Workshop on Adaptive and Reconfigurable Embedded Systems. (2012)
Goel Graduate Fellowship, selected among first year Ph.D. students in ECE at CMU. (2008 to 2009)
Employee Excellence Recognition, from LG Electronics for contributing to the development of the Radio Resource Control protocol of the HSDPA Modern Chipset. (2006)
First Rank Admission, out of 400 new employees participating in LG Electronics' challenging and competitive training program. (2004)
National Scholarship, endowed by the Korean Ministry of Science and Technology. (1999 to 2004)
National Tuition Waiver, endowed by the Korean Ministry of Science and Technology. (1999 to 2004)

SUMMARY OF RESEARCH AND PROFESSIONAL EXPERIENCE

Carnegie Mellon University, Pittsburgh, Pennsylvania, USA
Research Assistant, Electrical and Computer Engineering (August 2008 to Present)

General Motors, Warren, Michigan, USA
Intern, Research and Development (Summer 2011)
Intern, Research and Development (Summer 2010)

LG Electronics, Anyang, Korea
Research Engineer, Mobile Communication Technology Research Lab. (August 2004 to June 2008)

Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
Research Assistant, Electrical Engineering (August 2002 to August 2004)

LG Electronics, Anyang, Korea
Intern, Mobile Communication Technology Research Lab. (Summer 2001)

SUMMARY OF TEACHING EXPERIENCE

Carnegie Mellon University, Pittsburgh, Pennsylvania, USA
Teaching Assistant, Wireless Sensor Networks taught by Prof. Raj Rajkumar (Spring 2011)
Teaching Assistant, Embedded Real-Time Systems taught by Prof. Raj Rajkumar (Fall 2010)

Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
Teaching Assistant, Signals and Systems taught by Prof. Song Chong (Spring 2003)

RESEARCH PUBLICATIONS

- [W20] **Junsung Kim**, Young-Woo Seo, Hyoseung Kim, and Raj Rajkumar, *WiP Abstract: Can Cyber-Physical Systems be Predictable? Inferring Cyber-Workloads from Physical Attributes*, in the Work-in-Progress proceedings of the 5th annual ACM/IEEE International Conference on Cyber-Physical Systems (ICCPs), 2014.
- [C19] **Junsung Kim**, Björn Andersson, Dionisio de Niz, and Raj Rajkumar, *Segment-Fixed Priority Scheduling for Self-Suspending Real-Time Tasks*, in the Proceedings of the 34th annual IEEE Real-Time Systems Symposium (RTSS), 2013. (**22% acceptance rate, ~ 36/160**)
- [C18] Junqing Wei, Jarrod Snider, **Junsung Kim**, John Dolan, Raj Rajkumar, and Bakhtiar Litkouhi, *Towards a Viable Autonomous Driving Research Platform*, in the Proceedings of the 2013 IEEE Intelligent Vehicles Symposium (IV'13), 2013.
- [J17] **Junsung Kim**, Raj Rajkumar, and Markus Jochim, *Towards Dependable Autonomous Driving Vehicles: A System-Level Approach*, ACM SIGBED Review 10, 1, 2013.
- [J16] **Junsung Kim**, Raj Rajkumar, and Shinpei Kato, *Towards Adaptive GPU Resource Management for Embedded Real-Time Systems*, ACM SIGBED Review 10, 1, 2013.
- [W15] **Junsung Kim**, Praful Puranik, and Raj Rajkumar, *Realizing a Fault-Tolerant Embedded Controller on Distributed Real-Time Systems*, in the Proceedings of the 5th Workshop on Adaptive and Reconfigurable Embedded Systems (APRES), 2013.
- [C14] **Junsung Kim**, Hyoseung Kim, Karthik Lakshmanan, and Raj Rajkumar, *Parallel Scheduling for Cyber-Physical Systems: Analysis and Case Study on a Self-Driving Car*, in the Proceedings of the 4th Annual ACM/IEEE International Conference on Cyber-Physical Systems (ICCPs), 2013. (**4% nomination rate, ~ 4/103**) (Presented at the session of "**Best Paper Nominees**")
- [W13] Hyoseung Kim, **Junsung Kim**, and Raj Rajkumar, *A Profiling Framework in Linux/RK and its Application*, in the Proceedings of RTSS@Work, the open demo session of the 33rd annual IEEE Real-Time Systems Symposium (RTSS), 2012.
- [C12] **Junsung Kim**, Gaurav Bhatia, Raj Rajkumar, and Markus Jochim, *SAFER: System-Level Architecture for Failure Evasion in Real-Time Applications*, in the Proceedings of the 33rd annual IEEE Real-Time Systems Symposium (RTSS), 2012. (**22% acceptance rate, ~ 32/157**)

- [W11] **Junsung Kim**, Raj Rajkumar, and Shinpei Kato, *Towards Adaptive GPU Resource Management for Embedded Real-Time Systems*, in the Proceedings of the 4th Workshop on Adaptive and Reconfigurable Embedded Systems (APRES), 2012. (**Invited Paper**)
- [W10] **Junsung Kim**, Raj Rajkumar, and Markus Jochim, *SAFER: System-Level Architecture for Failure Evasion in Real-Time Applications*, in the Proceedings of the 4th Workshop on Adaptive and Reconfigurable Embedded Systems (APRES), 2012. (**Best Paper Award**)
- [C9] **Junsung Kim**, Karthik Lakshmanan, and Raj Rajkumar, *Rhythmic Tasks: A New Task Model with Continually Varying Periods for Cyber-Physical Systems*, in the Proceedings of the 3rd Annual ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS), 2012. (**7% nomination rate, ~ 3/41**) (Presented at the session of "**Best Paper Nominees**")
- [C8] Arvind Kandhalu, Karthik Lakshmanan, **Junsung Kim**, and Raj Rajkumar, *pCOMPATS: Period-Compatible Task Allocation and Splitting on Multi-Core Processors*, in the Proceedings of the 18th Annual IEEE International Conference on Real-Time Embedded Technology and Applications Symposium (RTAS), 2012. (**24% acceptance rate, ~ 30/127**)
- [C7] Arvind Kandhalu, **Junsung Kim**, Karthik Lakshmanan, and Raj Rajkumar, *Energy-Aware Partitioned Fixed-Priority Scheduling for Chip Multiprocessors*, in the Proceedings of the 17th Annual IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA), 2011. (**32% acceptance rate, ~ 25/79**)
- [C6] Vikram Gupta, **Junsung Kim**, Aditi Pandya, Karthik Lakshmanan, Raj Rajkumar, and Eduardo Tovar, *Nano-CF: A Coordination Framework for Macro-Programming in Wireless Sensor Networks*, in the Proceedings of the 8th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), 2011. (**27% acceptance rate, ~ 66/241**)
- [W5] Vikram Gupta, Eduardo Tovar, Luis Miguel Pinho, **Junsung Kim**, Karthik Lakshmanan, and Raj Rajkumar, *sMapReduce: A Programming Pattern for Wireless Sensor Networks*, in the Proceedings of the 2nd International Workshop on Software Engineering for Sensor Network Applications (SESENA 2011) to be held at ICSE 2011.
- [C4] **Junsung Kim**, Gaurav Bhatia, Raj Rajkumar, and Markus Jochim, *An AUTOSAR-Compliant Automotive Platform for Meeting Reliability and Timing Constraints*, SAE 2011 World Congress and Exhibition, 2011.
- [C3] **Junsung Kim**, Karthik Lakshmanan, and Raj Rajkumar, *R-BATCH: Task Partitioning for Fault-Tolerant Multiprocessor Real-Time Systems*, 2010 10th IEEE International Conference on Computer and Information Technology, 2010. (**20% acceptance rate, ~ 42/205**)
- [C2] **Junsung Kim**, M. Shin, S.L Shrestha, and S. Chong, *Energy-Aware Resource Allocation in WLAN Mobile Devices*, 2005 IEEE Global Telecommunications Conference, 2005.
- [C1] S. Yi, M. Shin, **Junsung Kim**, S.L Shrestha, and S. Chong, *Max-Min Resource Allocation in a Network Processor*, 2004 IEEE Global Telecommunications Conference, 2004.

PATENT APPLICATIONS

- [P6] *Method of Transmitting and Receiving in Wireless Communication Systems*, (application number 10-2007-0089664) submitted by **Junsung Kim**, Munyong Han, Myungjo Kim, and Jeonghun Ko.
- [P5] *Methods of Data Communication in Mobile Communication Systems*, (application number 10-2007-0089920) submitted by Munyong Han, **Junsung Kim**, Myungjo Kim, and Jeonghun Ko.
- [P4] *Methods of Setting Up Radio Connection for Data Transmission Service*, (application number 10-2007-0104211) submitted by Myungjo Kim, Munyong Han, **Junsung Kim**, and Jeonghun Ko.
- [P3] *Method of Data Transmission Using HARQ*, (application number 10-2007-0107542) submitted by Munyong Han, **Junsung Kim**, Myungjo Kim, and Jeonghun Ko.

- [P2] *Method of Transmitting Data using Multiple Transport Channel*, (application number 10-2007-0122767) submitted by **Junsung Kim**, Munyong Han, Myungjo Kim, and Jeonghun Ko.
- [P1] *Method of Transmitting and Receiving Data in Wireless Communication System*, (application number 10-2007-0126271) submitted by **Junsung Kim**, Munyong Han, Myungjo Kim, and Jeonghun Ko.

SELECTED TALKS AND GUEST LECTURES

- [L15] *Data Dissemination*, 18-748: Wireless Sensor Networks, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, April 2014.
- [T14] *Dependable Cyber-Physical Systems*, the University of Michigan, Ann Arbor, Michigan, USA, April 2014.
- [T13] *Dependable Cyber-Physical Systems*, UCLA, Los Angeles, California, USA, February 2014.
- [T12] *Segment-Fixed Priority Scheduling for Self-Suspending Real-Time Tasks*, Real-Time Systems Symposium, Vancouver, British Columbia, Canada, December 2013.
- [T11] *Parallel Scheduling for Cyber-Physical Systems: Analysis and Case Study on a Self-Driving Car*, International Conference on Cyber-Physical Systems, Philadelphia, Pennsylvania, USA, April 2013.
- [T10] *Realizing a Fault-Tolerant Embedded Controller on Distributed Real-Time Systems*, Workshop on Adaptive and Reconfigurable Embedded Systems, Philadelphia, Pennsylvania, USA, April 2013.
- [T9] *SAFER: System-Level Architecture for Failure Evasion in Real-Time Applications*, Real-Time Systems Symposium, San Juan, Puerto Rico, USA, December 2012.
- [T8] *SAFER: System-Level Architecture for Failure Evasion in Real-Time Applications*, Hyundai Global Top Talent Forum, San Diego, California, USA, September 2012.
- [T7] *Rhythmic Tasks: A New Task Model with Continually Varying Periods for Cyber-Physical Systems*, International Conference on Cyber-Physical Systems, Beijing, China, April 2012.
- [T6] *SAFER: System-Level Architecture for Failure Evasion in Real-Time Applications*, Workshop on Adaptive and Reconfigurable Embedded Systems, Beijing, China, April 2012.
- [T5] *An AUTOSAR-Compliant Automotive Platform for Meeting Reliability and Timing Constraints*, SAE World Congress and Exhibition, Detroit, Michigan, USA, April 2011.
- [L4] *Localization*, 18-748: Wireless Sensor Networks, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, April 2011.
- [L3] *The CMU FireFly Platform*, 18-748: Wireless Sensor Networks, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, January 2011.
- [T2] *R-BATCH: Task Partitioning for Fault-Tolerant Multiprocessor Real-Time Systems*, International Conference on Embedded Software and Systems, Bradford, West Yorkshire, UK, June 2010.
- [T1] *Energy-Aware Resource Allocation in WLAN Mobile Devices*, Global Telecommunications Conference, St. Louis, Missouri, USA, November 2005.

RESEARCH MENTORING

- Uttkarsh Sarraf, *Hidden Markov Model-based Map Matching*, Summer 2013
- Dipendra Kumar Misra, *Smart Ways to Use GPUs in Autonomous Vehicles*, Summer 2012
- Praful Puranik, *Fault-Tolerant Controllers in Self-Driving Cars*, Summer 2012
- Shashank Sonkar (co-mentored with Gaurav Bhatia), *Map Databases and Extractions*, Summer 2012
- Aditi Pandya, *Macro-programming in Wireless Sensor Networks*, Spring 2011

PROFESSIONAL SERVICE

- IEEE CPSNA*, served as an external reviewer. (2013)

ACM/IEEE ICCPS, served as an external reviewer. (2010)

IEEE RTAS, served as an external reviewer. (2011 – 12, 2014)

IEEE RTSS, served as an external reviewer. (2009 – 10, 2013)

GM-CMU Autonomous Driving Collaborative Research Lab., served as a “process czar.” (2013 to Present)

Korean Graduate Student Association in ECE at CMU, served as a chair. (2011 to 2013)

Information Technology Research Center Forum, selected to represent our KAIST research group at a prestigious forum sponsored by the Korean Ministry of Information and Communication. (2004)

DETAILS OF RESEARCH EXPERIENCE

Graduate Research Assistant with Prof. Raj Rajkumar (Fall 2008 to Present)

- *Timeliness Analyses for Cyber-Physical Systems (CPS)*: Proposed a new model called *Rhythmic Tasks* representing CPS tasks with continually varying periods. Provided a mathematically proven method of finding schedulable utilization levels for the rhythmic tasks [C9]. Developed a technique for efficiently scheduling parallel tasks in CPS context. Implemented the new scheduling algorithm on an autonomous vehicle as a proof of concept and showed that the algorithm improved autonomous driving quality [C14]. Also proposed a novel approach to self-suspending tasks [C19].
- *Fault-Tolerant Real-Time Computing Platform for CPS*: Modeled and classified real-time tasks into three different categories based on recovery-time requirements. Proposed a partitioned real-time scheduling algorithm that saved up to 45% of computing resources compared to conventional methods when task-level replications were used [C3]. Integrated the proposed algorithm into AUTOSAR (Automotive Open System Architecture) [C4]. Designed and implemented a distributed layer supporting fault-tolerance schemes such as hot standby, cold standby, and re-execution. Deployed the distributed layer in an autonomous vehicle as a proof of concept [W10, C12]. Proposed an architecture extended from the distributed layer to tolerate sensor/actuator failures on an autonomous vehicle [W15, J17].
- *Map-Matching Algorithm for Autonomous Driving*: Developed a method leveraging vision-based lane marking detection algorithms to correct vehicle pose errors in lateral directions (perpendicular to driving direction) to achieve a lane-level localization. Used a Hidden Markov Model based algorithm for longitudinal corrections. Showed that autonomous driving was possible in COTS GPS settings.
- *Autonomous Vehicle Development* [C18]: Identified the computing platform specifications. Identified the types and locations of different kinds of sensors, including cameras, radars and LIDARs, with the consideration of sensing coverage and fault-tolerance. Integrated the radar/camera data into the perception layer. Tailored the build environment and OS for the autonomous vehicle. Configured the time synchronization modules. Successfully demonstrated the vehicle to various audiences, including US Congressman and House Transportation and Infrastructure Committee Chairman Bill Shuster.
- *Energy Management for Multi-Core Smartphones*: Developed and evaluated an energy-aware partitioned scheduling algorithm on multi-core mobile processors. Implemented and evaluated the proposed algorithm in the Android kernel managing Dynamic Voltage and Frequency Scaling [C7]. Proved that more energy would be saved when *period-compatible* tasks were allocated together [C8].
- *Macro-Programming Framework for Wireless Sensor Networks*: Proposed a programming framework for simultaneous multi-application support [W5, C6]. Developed an adaptive programming language to support the framework. Implemented a routing protocol for reliable application delivery. Proposed a new aggregate scheme for energy-saving data transmission [C6].

- *Vehicle-to-Vehicle (V2V) Communication for Autonomous Driving*: Analyzed the behavior of Dedicated Short-Range Communication, the MAC protocol for vehicular communication systems. Proposed requirements for V2V communication for autonomous driving.

Graduate Research Assistant with Prof. Song Chong at KAIST (Fall 2002 to Spring 2004)

- *Energy-Aware Resource Allocation in Mobile Devices [C2]*: Developed and evaluated an energy-aware resource management algorithm for mobile devices. Proposed a novel algorithm to extend battery lifetime of mobile devices and maximize user throughput by fairly and efficiently managing usage.
- *Max-Min Resource Allocation in Network Processors [C1]*: Successfully tested and implemented an internet router with a cutting-edge resource allocation algorithm by using the Intel IXP1200 network processor platform.

DETAILS OF PROFESSIONAL EXPERIENCE

Research Intern with Dr. Markus Jochim at General Motors (Summer 2011)

- *Fault-Tolerant Distributed Middleware for Autonomous Driving*: Designed and implemented a distributed layer on Linux to support fault-tolerance features such as software-level replications and re-execution for autonomous driving. Demonstrated failure recovery scenarios on an autonomous-vehicle computing platform when processor failures occurred.
- Contributed to an ongoing internal project related to in-vehicle network analyses.

Research Intern with Dr. Markus Jochim at General Motors (Summer 2010)

- *Resource-Aware Failure Recovery for Autonomous Driving*: Proposed, developed, and evaluated an algorithm to deal with varying resource demands based on different failure scenarios in autonomous driving. Showed and addressed counter-intuitive scenarios in which degraded driving modes caused by failures actually demanded more resources.
- Contributed to an on-going internal project related to automotive security.

Research Engineer at LG Electronics (August 2004 to June 2008)

- *Radio Resource Control (RRC)*: Contributed to a large-scale project developing a Long Term Evolution (LTE) modem chip commercialized in late 2008. Led design, development, and evaluation of the architecture, interface, and functionality of the Lower Layer Configuration Module (LLCM) in RRC, the management tier of all radio resources in LTE and High Speed Downlink Packet Access (HSDPA) systems. Successfully developed a protocol stack for LLCM responsible for the L3 procedures, L2 (MAC) scheduling, and L1 (PHY) resource management of the LTE and HSDPA systems.
- Conducted research on the air interface with cellular networks, developing a strong understanding of both the user side and the network side of wireless networks. Wrote seven domestic patent applications [P1– P6].

Intern at LG Electronics (Summer 2001)

- Analyzed behaviors of Code Division Multiple Access (CDMA) base stations of LG Electronics.
- Contributed to the development of the prototype of an HSDPA base station by sharing with developers the technical specifications of the 3rd Generation Partnership Project (3GPP).

DETAILS OF TEACHING EXPERIENCE

Teaching Assistant for Wireless Sensor Networks taught by Prof. Raj Rajkumar (Spring 2011)

- *Labs*: Mentored five semester-long projects on a fault-tolerant MAC protocol for wireless sensor nodes, a distributed home surveillance system, a seamless handoff protocol for 6LowPAN, an in-

vehicle baby health monitoring system, and a coordinated movement protocol for iRobot Roombas. Guided and evaluated these projects from conception to completion, assisting students in showcasing their ideas during demos.

- *Lectures*: Lectured on localization in wireless sensor networks and the fundamentals of the FireFly sensor node developed at CMU. Provided questions and solutions for quizzes. Evaluated quizzes and examinations.

Teaching Assistant for Embedded Real-Time Systems taught by Prof. Raj Rajkumar (Fall 2010)

- *Labs*: Designed, implemented, and evaluated laboratory exercises involving Linux kernel programming and Android application development for Motorola Droid smartphones.
- *Lectures*: Lectured on the fundamentals of Linux. Provided questions and solutions for examinations on real-time scheduling. Evaluated quizzes and examinations.

Teaching Assistant for Signals and Systems taught by Prof. Song Chong (Spring 2003)

- *Lectures*: Provided questions and solutions for midterm and final examinations. Evaluated homework exercises.

REFERENCES

Available upon request.