

# Gunjae Koo

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## CONTACT INFORMATION

*Address:*  
145 Anam-ro, Woojung Hall of Informatics 403  
Seongbuk-gu, Seoul 02841, South Korea

*Phone:* +82-2-3290-4607  
*E-mail:* [gunjaekoo@korea.ac.kr](mailto:gunjaekoo@korea.ac.kr)  
*Homepage:* <http://gunjaekoo.com>  
*Lab:* <http://csarch.korea.ac.kr>

## EDUCATION

**University of Southern California**, Los Angeles, CA

Ph.D., Electrical Engineering, Aug 2018

- Thesis: *Architectural Innovations for Mitigating Data Movement Cost on Graphics Processing units and Storage Systems*
- Adviser: Professor Murali Annavaram
- Area of Study: computer architecture, parallel processor architecture, storage & memory systems, in-storage data analytics, embedded systems, high-performance computing

**Seoul National University**, Seoul, South Korea

M.S., Electrical Engineering and Computer Science, Feb 2003

- Thesis: *An Equalizer and Viterbi Decoder Design for 1000BASE-T Gigabit Ethernet*
- Adviser: Professor Deog-Kyoon Jeong
- Area of Study: digital system design, VLSI, model-based design, signal processing, communication theory

B.S., Electrical Engineering, Feb 2001

- Thesis: *2.4GHz Low Noise Amplifier Design in a 0.25  $\mu$ m CMOS Technology*
- Electrical specialization (emphasis on digital CMOS circuits design, digital systems design, computer systems and signal processing)

## PROFESSIONAL EXPERIENCE

**Korea University**, Seoul, South Korea

*Assistant Professor (Tenure Track)*

**Mar 2020 to present**

- Area of Research: computer architecture, memory & storage systems, accelerators, secure architecture

**Hongik University**, Seoul, South Korea

*Assistant Professor (Tenure Track)*

**Sep 2018 to Feb 2020**

- Area of Research: computer architecture, memory & storage systems, FPGA, Accelerator, embedded systems

**University of Southern California**, Los Angeles, CA

*Graduate Research Assistant*

**Aug 2012 to Aug 2018**

- Advisor: Professor Murali Annavaram
- Area of Research: computer architecture, embedded systems, storage systems, near data processing, GPGPU, memory systems, energy efficient computing

**Intel**, Hillsboro, OR

*Graduate Research Intern*

**May 2016 to Dec 2016**

- Area of Research: memory controller for server architecture, next-generation memory technology

**LG Electronics**, Seoul, South Korea

*Senior Research Engineer*

**Apr 2008 to May 2011**

- SoC Group. System IC Laboratory / Digital TV Laboratory
- Area of Research: SoC design, FPGA platform design, digital system architecture & modeling, RTL design, verification & validation, image processing algorithm, image analysis

*Senior Research Engineer*

**Jul 2005 to Apr 2008**

- SoC Core Technology Group, Device & Material Laboratory
- Area of Research: SoC design, digital system architecture & modeling, RTL design, signal processing algorithm

*Junior Research Engineer*

**Mar 2003 to Jul 2005**

- Digital Media ASIC group, Digital Storage Research Laboratory
- Area of Research: signal processing algorithm, communication theory, RTL design & verification

**Seoul National University**, Seoul, South Korea

*Graduate Research Assistant*

**Mar 2001 to Feb 2003**

- Advisor: **Professor Deog-Kyoon Jeong**
- Area of Research: digital system design, verification, testing, signal processing algorithm, communication theory

**Bitnuri**, Seoul, South Korea

*Researcher (co-founder)*

**Mar 2000 to Dec 2000**

- Area of Research: digital system design

**PUBLICATIONS**

**Refereed Conferences**

- [1] Yeong Seo Lee, Gunjae Koo, Young-Ho Gong, and Sung Woo Chung. "Stealth ECC: A Data-Width Aware Adaptive ECC Scheme for DRAM Error Resilience" *Design, Automation and Test in Europe Conference (DATE '22)*, To appear.
- [2] Jongmin Lee, Junyeon Lee, Taeweon Suh, and Gunjae Koo. "CacheRewinder: Revoking Speculative Cache Updates Exploiting Write-Back Buffer" *Design, Automation and Test in Europe Conference (DATE '22)*, To appear.
- [3] Jongmin Lee and Gunjae Koo. "Restore Buffer Overflow Attacks: Breaking Undo-Based Defense Schemes" *Proceedings of the 36th International Conference on Information Networking (ICOIN '22)*, Jan 12–15, 2022.
- [4] Kiran Kumar Matam, Gunjae Koo, Haipeng Zha, Hung-Wei Tseng, and Murali Annavaram. "GraphSSD: Graph Semantics Aware SSD". *Proceedings of the 46th Annual International Symposium on Computer Architecture (ISCA '19)*, Jun 22–26, 2019.
- [5] Yunho Oh, Gunjae Koo, Murali Annavaram, and Won Woo Ro. "Linebacker: Preserving Victim Cache Lines in Idle Register Files of GPUs". *Proceedings of the 46th Annual International Symposium on Computer Architecture (ISCA '19)*, Jun 22–26, 2019.
- [6] Gunjae Koo, Hyeran Jeon, Zhenhong Liu, Nam Sung Kim, and Murali Annavaram. "CTA-Aware Prefetching and Scheduling for GPU". *Proceedings of the 32nd IEEE International Parallel and Distributed Processing Symposium (IPDPS '18)*, May 21–25, 2018.

- [7] Gunjae Koo, Kiran Kumar Matam, Te I, Hema Venkata Krishna Giri Nara, Jing Li, Hung-Wei Tseng, Steven Swanson, and Murali Annavaram. "Summarizer: Trading Communication with Computing Near Storage". *Proceedings of the 50th Annual IEEE/ACM International Symposium on Microarchitecture (MICRO '17)*, Oct 14–18, 2017.
- [8] Gunjae Koo, Yunho Oh, Won Woo Ro, and Murali Annavaram. "Access Pattern-Aware Cache Management for Improving Data Utilization in GPU". *Proceedings of the 44th Annual International Symposium on Computer Architecture (ISCA '17)*, Jun 24–28, 2017.
- [9] Keunsoo Kim, Sangpil Lee, Myung Kuk Yoon, Gunjae Koo, Won Woo Ro, and Murali Annavaram. "Warped-Preexecution: A GPU Pre-execution Approach for Improving Latency Hiding". *Proceedings of the 22nd International Symposium on High Performance Computer Architecture (HPCA '16)*, Mar 12–16, 2016.
- [10] Gunjae Koo, Hyeran Jeon, and Murali Annavaram. "Revealing Critical Loads and Hidden Data Locality in GPGPU Applications". *Proceedings of the 2015 IEEE International Symposium on Workload Characterization (IISWC '15)*, Oct 4–6, 2015.
- [11] Sangpil Lee, Keunsoo Kim, Gunjae Koo, Hyeran Jeon, Won Woo Ro, and Murali Annavaram. "Warped-Compression: Enabling Power Efficient GPUs through Register Compression". *Proceedings of the 42nd Annual International Symposium on Computer Architecture (ISCA '15)*, Jun 13–17, 2015.
- [12] Gunjae Koo, Kyoung Won Lim, and Seung Jong Choi. "Complementary Block-Based Motion Estimation for Frame Rate Up-Conversion". *The 2011 IEEE International Conference on Consumer Electronics (ICCE '11)*, Jan 9–12, 2011.
- [13] Gunjae Koo, Woochul Jung, and Heesub Lee. "A Robust PRML Read Channel with Digital Timing Recovery for Multi-Format Optical Disc". *Proceedings of the 2006 IEEE International Symposium on Circuits and Systems (ISCAS '06)*, May 21–24, 2006.

#### **Journals**

- [14] Minkyu Song, Junyeon Lee, Taeweon Suh, and Gunjae Koo. "RT-Sniper: A Low-Overhead Defense Mechanism Pinpointing Cache Side-Channel Attacks". *MDPI Electronics*, Vol. 10, No. 22. 2021.
- [15] Won Jeon, Jun Hyun Park, Yoonsoo Kim, Gunjae Koo, and Won Woo Ro. "Hi-End: Hierarchical, Endurance-Aware STT-MRAM-Based Register File for Energy-Efficient GPUs". *IEEE Access*, Vol. 8, pp. 127768–127780. 2020.
- [16] Sangpil Lee, Keunsoo Kim, Gunjae Koo, Hyeran Jeon, Murali Annavaram and Won Woo Ro. "Improving Energy Efficiency of GPUs through Data Compression and Compressed Execution". *IEEE Transactions on Computers*, Vol. 66, No. 5, pp. 834–847. 2017.
- [17] Kyoung Won Lim, Hansoo Kim, Hyunchul Noh, Hyunchul Shin, Woochul Jung, Gunjae Koo and Ryuk Park. "Advanced Frame Rate Conversion without Halo and Judder Effect for 120Hz LCD Displays". *iMiD/IDMC/Asia Display*, Vol. 8 Book-II, pp. 1397–1400. 2008.

#### **Workshops and Technical Reports**

- [18] Gunjae Koo, Kiran Kumar Matam, Te I, Hema Venkata Krishna Giri Nara, Jing Li, Hung-Wei Tseng, Steven Swanson, and Murali Annavaram. "Dynamic Near Data Processing Framework for SSDs". *The 9th Annual Non-Volatile Memories Workshop (NVMW '18)*, Mar 11–13, 2018.

- [19] Hyeran Jeon, Gunjae Koo and Murali Annavaram. "CTA-aware Prefetching for GPGPU". *Computer Engineering Technical Report, Ming Hsieh Department of Electrical Engineering, University of Southern California*, Oct, 2014.

#### **Refereed Conferences (Korea)**

- [20] Inje Kim and Gunjae Koo. "Analyzing the Performance of GCN Inferences with respect to Sparsity of Graph Features". *Proceedings of the 2021 Korea Software Congress (KSC '21)*, Dec 20–22, 2021.
- [21] Jonghyun Jeong, Yunho Oh, and Gunjae Koo. "Analyzing Data Cache Performance of Modern GPU Architecture". *Proceedings of the 2021 Korea Software Congress (KSC '21)*, Dec 20–22, 2021.
- [22] Seungho Jung, Myung Kuk Yoon, and Gunjae Koo "Analyzing Characteristics of Memory Timing Side-Channels in GPU". *Proceedings of the 2021 Korea Software Congress (KSC '21)*, Dec 20–22, 2021.
- [23] Inje Kim and Gunjae Koo. "Revealing Characteristics of GCN Inference Models Using a GPU Profiler". *Proceedings of the 2021 Korea Computer Congress (KCC '21)*, Jun 23–25, 2021.
- [24] Hunjong Lee, Junhwan Yoo, and Gunjae Koo. "Audio Compression Accelerator Design for Improving the Response Time of AI Speakers". *Proceedings of the 2020 Summer Annual Conference of IEIE (IEIE '20)*, Aug 19–21, 2020
- [25] Gunjae Koo, Wochul Jung, and Heesub Lee. "A PRML Read Channel for High Density Optical Disc". *Proceedings of the 13th Korean Conference on Semiconductors*. Feb 23–24, 2006.

#### **Thesis**

- [26] Gunjae Koo. "Architectural Innovations for Mitigating Data Movement Cost on Graphics Processing units and Storage Systems". *Ph.D. Dissertation. Department of Electrical Engineering, University of Southern California*, Aug, 2018.
- [27] Gunjae Koo. "An Equalizer and Viterbi Decoder Design for 1000BASE-T Gigabit Ethernet". *M.S. Thesis, Department of Electrical Engineering and Computer Science, Seoul National University*, Feb, 2003.

#### **PATENTS**

##### **U.S. Patents**

- [1] Murali Annavaram, Gunjae Koo, Kiran Kumar Matam, and Hung-Wei Tseng. "Dynamic Near-Data Processing Control Mechanism Based on Computer Resource Availability on Solid-State Disk Platforms". *U.S. Patent Pub. No. US 2020/0310690 A1*, Oct 1, 2020.
- [2] Gunjae Koo, Vivek Kozhikkottu, Shankar Ganesh Ramasubramanian, and Christopher B. Wilkerson. "Increasing Read Pending Queue Capacity to Increase Memory Bandwidth". *U.S. Patent Pub. No. US 2018/0188976 A1*, Jul 5, 2018.
- [3] Gunjae Koo and Eun Pyo Lee. "Frequency Detection Method for Optical Disc Bit Reproduction Apparatus". *U.S. Patent No. US 7,433,289*, Oct 7, 2008.

##### **Korean Patents**

- [4] Gunjae Koo, Jongmin Lee, Junyeon Lee, and Taeweon Suh. "Processor and Operation Thereof to Revoke Cache Memory States Utilizing Write-Back Buffer". *Korea Patent 10-2021-0179950*, Dec 15, 2021.
- [5] Gunjae Koo. "Motion Estimation Method for Video Signal". *Korea Patent 10-2012-0106279*, Sep 26, 2012.

- [6] Gunjae Koo. "Method of Frame Interpolation by Complementary Motion Estimation Algorithm". *Korea Patent 10-2011-0034241*, Apr 5, 2011.
- [7] Gunjae Koo. "Method of Assigning Motion Vector of Occlusion Region". *Korea Patent 10-2011-0034242*, Apr 5, 2011.
- [8] Gunjae Koo and Heesub Lee. "Liquid Crystal Display". *Korea Patent 10-2007-0077746*, Jul 27, 2007.
- [9] Gunjae Koo and Hansoo Kim. "Method for Generating CAV Clock of Optical Disc". *Korea Patent 10-2007-0028754*, Mar 13, 2007.
- [10] Gunjae Koo and Hyugin Kwon. "Adaptive Boost Gain Controlled Limit Equalizer and Gain Calculation Method in Above Limit Equalizer". *Korea Patent 10-2006-0073662*, Oct 12, 2006.
- [11] Gunjae Koo. "Optical Recording System for Detecting Frequency of Read Channel Using Wobble Signal and Playback Method Thereof". *Korea Patent 10-2006-0036534*, Jun 15, 2006.
- [12] Gunjae Koo and Eun Pyo Lee. "Frequency Detecting Method in Optical Disk Bit Data Reproducing System". *Korea Patent 10-2005-0080866*, Jun 23, 2006.
- [13] Gunjae Koo and Youngsoo Jang. "Apparatus of Detecting in Optical Disc and Method of Same". *Korea Patent 10-2005-0076072*, Apr 28, 2006.

TALKS

- [1] Architectural Innovations for Big Data.  
*Korea University, Seoul, South Korea, Nov 2019.*  
*Seoul National University, Seoul, South Korea, Nov 2019.*
- [2] Architectural Approaches for Accelerating Big Data.  
*IEIE SoC Conference, Daejeon, South Korea, May 2019.*
- [3] Diving into Data: Architectural Approaches to In-Storage Computing.  
*KIISE Computer System Society Conference, Pyeongchang, South Korea, Jan 2019.*
- [4] GPU Memory System Architecture for Big Data.  
*EDA Winter Workshop, Pyeongchang, South Korea, Jan 2019.*
- [5] CTA-Aware Prefetching and Scheduling.  
*IPDPS '18, Vancouver, British Columbia, Canada, May 2018.*
- [6] Dynamic Near Data Processing Framework for SSDs.  
*NVMW '18, La Jolla, California, Mar 2018.*
- [7] Architectural Challenges and Innovation for Accelerating Big Data Analytics.  
*Yonsei University, Seoul, South Korea, Sep 2018.*  
*Postech, Pohang, South Korea, Jun 2018.*  
*Texas A&M University, College Station, Texas, Apr 2018.*  
*University of Central Florida, Orlando, Florida, Apr 2018.*  
*Binghamton University, Binghamton, New York, Mar 2018.*  
*University of California Santa Cruz, Santa Cruz, California, Mar 2018.*
- [8] Summarizer: Trading Communication with Computing Near Storage.  
*MICRO '17, Cambridge, Massachusetts, Oct 2017.*
- [9] Access Pattern-Aware Cache Management for Improving Data Utilization in GPU.  
*ISCA '17, Toronto, Ontario, Canada, Jun 2017.*

- [10] Revealing Critical Loads and Hidden Data Locality in GPGPU Applications.  
*IISWC '15, Atlanta, Georgia, Oct 2015.*
- [11] Complementary Block-Based Motion Estimation for Frame Rate Up-Conversion.  
*ICCE '11, Las Vegas, Nevada, Jan 2011.*

FUNDING

- [1] Research on Processor and Memory Architecture for Neural Networks using Large Graph Structures.  
*Supported by National Research Foundation of Korea (NRF) No. NRF-2021R1C1C1012172, Mar 2021 to Feb 2026.*
- [2] BK21 Four (Fostering Outstanding Universities for Research).  
*Supported by the Ministry of Education (MOE) and National Research Foundation of Korea (NRF), Sep 2020 to Aug 2027.*
- [3] ICT Creative Consilience Program.  
*Supported by Institute of Information and Communications Technology Planning and Evaluation (IITP) IITP-2021-2020-0-01819, Jul 2020 to Jun 2030.*
- [4] Regional Strategic Industry Convergence Security Core Talent Training Business.  
*Supported by Institute of Information and Communications Technology Planning and Evaluation (IITP) No. 2019-0-01343, May 2019 to Dec 2022.*
- [5] Research on CPU Vulnerability Detection and Validation.  
*Supported by Institute of Information and Communications Technology Planning and Evaluation (IITP) No. 2019-0-00533, Apr 2019 to Dec 2022.*
- [6] Research on Near Data Processing (NDP) Systems for Machine Learning Applications.  
*Supported by National Research Foundation of Korea (NRF) No. NRF-2018R1C1B5086594, Sep 2018 to Aug 2021.*

TEACHING  
EXPERIENCE

**Korea University**, Seoul, South Korea

*Instructor*

- COSE222: Computer Architecture Spring 2020 to Fall 2021
- AAA751: Storage System Architecture Fall 2021
- SWS115: Secure Hardware Architecture Spring 2021
- AAA634: Advanced Processor Architecture Spring 2021
- AAA604: Parallel Processor Architecture Fall 2020
- AAA514: Advanced Computer Architecture Spring 2020

*Students Supervised*

- Dongjae Lee, Korea University (Undergraduate, 2021)
- Hyunwoo Moon, Korea University (Undergraduate, MS student, 2021–)
- Hunjong Lee, Korea University (MS student, 2021–)
- Myungjune Shin, Korea University (MS student, 2021)
- Boyoung Park, Korea University (MS student, 2021–)
- Jonghyun Jeong, Korea University (MS student, 2021–)
- Inje Kim, Korea University (MS student, 2021–)
- Jongmin Lee, Korea University (PhD student, 2020–)
- Seungho Jung, Korea University (MS student, 2020–)

**Hongik University**, Seoul, South Korea

*Instructor*

- 106827: Introduction to IoT Design Fall 2019
- 106824: Storage System Architecture (IT System Design) Spring 2019
- 106202: Digital Logic Design Spring 2019
- 106601: Computer Architecture Fall 2018
- 106610: Computer Communication Network Fall 2018
- 106818: Embedded System Design Fall 2018, Fall 2019

*Students Supervised*

- Junhwan Yoo, Hongik University (Undergraduate, 2019)
- Hunjong Lee, Hongik University (Undergraduate, 2019–2020)
- Inje Kim, Hongik University (Undergraduate, 2019–2020)
- Boyoung Park, Hongik University (Undergraduate, 2019–2020)
- Segon Oh, Hongik University (Undergraduate, 2019)
- Juhyeon Kim, Hongik University (Undergraduate, 2019–2020)
- Seungho Jung, Hongik University (Undergraduate, 2019–2020)

**University of Southern California**, Los Angeles, CA

*Teaching Assistant*

- EE 354: Introduction to Digital Circuits Fall 2015, Spring 2016
- EE 560: Digital System Design - Tools and Techniques Summer 2013
- EE 557: Computer Systems Architecture Fall 2013, Spring 2014

*Students Mentored*

- Rohit Madan, University of Southern California (Direct Research, Fall 2017)
- Yung-Hung Chen, University of Southern California (Direct Research, Fall 2017)
- Qili Wang, University of Southern California (Intern, Summer 2017)
- Chirag Ahuja, University of Southern California (Direct Research, Spring 2015)
- Kevin Jia, University of Southern California (Intern, Summer 2014)
- Sangmin Kim, University of Southern California (Direct Research, Spring 2014)

**Inter-university Semiconductor Research Center**, Seoul, South Korea

*Teaching Assistant*

- VLSI Design Coursework Jan 2002

**Seoul National University**, Seoul, South Korea

*Teaching Assistant*

- Electronics Circuits Spring 2001
- Analog System Laboratory Fall 2001

PROFESSIONAL  
SERVICES

**Conference/Workshop Organization**

- The 27th IEEE International Symposium on High-Performance Computer Architecture (*HPCA '21*), Feb 2021.

**Conference/Workshop Session Chair**

- The 9th Annual Non-Volatile Memories Workshop (*NVMW '18*), Mar 2018.

### **Conference/Workshop Program Committee**

- The 14th Workshop on General Purpose Processing Using GPU (*GPGPU '22*), Apr 2022.
- The 10th IEEE Non-Volatile Memory Systems and Applications Symposium (*NVMSA '21*), Aug 2021.
- The 27th IEEE International Symposium on High-Performance Computer Architecture (*HPCA '21*), Feb 2021.
- The 9th IEEE Non-Volatile Memory Systems and Applications Symposium (*NVMSA '20*), Aug 2020.
- The 13th Workshop on General Purpose Processing Using GPU (*GPGPU '20*), Feb 2020.

### **Panelist**

- USC Viterbi PhD Academic Career Mentoring Panel, May 2018.

### **Reviewer/External Reviewer**

- IEEE Transactions on Emerging Topics in Computing (*TETC*)
- IEEE Transactions on Computers (*TC*)
- IEEE Internet of Thing Journal (*IOT-J*)
- IEEE/ACM International Symposium on Computer Architecture (*ISCA*)
- IEEE/ACM International Symposium on Microarchitecture (*MICRO*)
- ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Systems (*SIGMETRICS*)
- IEEE International Parallel and Distributed Processing Symposium (*IPDPS*)
- IEEE International Symposium on Workload Characterization (*IISWC*)
- IEEE International Conference on Computer Design (*ICCD*)
- IEEE International Symposium on Performance Analysis of Systems and Software (*ISPASS*)
- IEEE Computer Architecture Letters (*CAL*)
- ACM Transactions on Embedded Computing Systems (*TECS*)

### **AWARDS AND HONORS**

#### **University of Southern California**

- Viterbi School of Engineering Doctoral Fellowship, Aug 2011–Jul 2015

#### **LG Electronics**

- The 2009 LG Group Best R&D Products Award: 4th prize, Mar 2010
- The 2008 Outstanding Researcher Award in DTV Research Laboratory, Jan 2009

#### **Seoul National University**

- Honors Scholarship in the Department of Electrical Engineering, Mar 1999

### **HARDWARE AND SOFTWARE SKILLS**

#### **Storage System Development Platforms**

- Dragonfire board (Intelligent-SSD)
- OpenSSD

#### **Computer Architecture Simulators**

- Processor simulators: GPGPU-sim, DRAMSim, Ramulator, ZSim, Gem5, SimpleScalar, SESC, Multi2Sim.
- Power estimation: McPat, Wattch, CACTI.

#### **SoC and VLSI Design**

- Hardware description languages: Verilog, VHDL
- RTL simulation and verification tools: NCsim, Verdi, ModelSim
- RTL coverage and lint tools: ICCR, Spyglass
- Logic synthesis tool: Synopsys design compiler
- FPGA tools: Xilinx Vivado, Intel Quartus Prime, Chipscope
- ASIC emulation tool: ZeBu



Modeling and Analysis

- Analysis tool: Matlab
- Model-based design tool: Simulink

Programming

- Programming languages: C, C++, Python
- Script languages: bash shell, GNU make, Perl
- Version control tools: git, SVN, CVS

MEMBERSHIPS

ACM SIGARCH member  
IEEE member  
SID member  
Samsung frontier membership  
AYSO (American Youth Soccer Organization) referee

REFERENCES

*References are available upon request.*