Overview

Computer science and engineering is the academic discipline devoted to the study and research of various aspects of computation and computers. It covers a wide range of subjects relating to computing, from the theoretical foundations of computing to application systems based on information technology. Our goal is to further our knowledge of algorithms, techniques, and applications for all components of computing systems. Considering that most human activities use information in a high tech society, the significance of computer science and engineering is paramount, not only to maintain a technological edge but also to improve people's quality of life.
The Department of Computer Science and Engineering at POSTECH conducts world-class research in a comprehensive range of information technology areas described as follows.

**CS Computing Systems**
Computing Systems aims to develop and operate various optimal computer systems with consideration of performance, cost, and reliability, from the device level to a large scale computing environment. It is a fundamental field that props up the computer-based IT industry. At the core of its importance lies in-depth knowledge in theory and practice of hardware and software in a large scope.

**NS Network Systems**
Network Systems is an essential field in the modern computer industry in which information is disseminated by many connected computers. Not only that, its increasing role as an infrastructure that supports various fields including BT and NT is ever more important.

**SC Computer Security**
Computing Security aims to develop techniques for protecting computer systems and networks from the theft or damage to the software and hardware. Its importance is rapidly growing as reliance on computer systems is increasing. The department at POSTECH covers systems security, software security, mobile security, and IoT security.

**HCI/NLP Human-Computer Interaction/Natural Language Processing**
HCl studies everything related to two-way communication between users and computers, based on the fact that it is human beings who use computers. It is one of the most exemplary interdisciplinary fields combining computer engineering-based technology with humanitarian studies, which has its basis in psychology, sociology, etc.

**SP Software Engineering & Programming Languages**
Software Engineering & Programming Languages aims to develop programming languages and software that provide theoretical backgrounds and facilitate communication between the computer and human beings, which are indispensable to computing theory, logic, language theory within the computing environment.

**VC Visual Computing**
Visual Computing aims to recognize, search, analyze, synthesize, and process images and videos. It covers a wide variety of subfields including Computer Graphics and Computer Vision. Computer Graphics aims to develop algorithms and techniques that can help create images and videos, and Computer Vision aims to develop algorithms for analyzing images and videos.

**DS Data Science**
Data Science aims to recognize, search, analyze, process, and represent data and deliver them effectively to users. Data science has critical importance in today’s IT world where a massive amount of data is generated from a wide variety of sources in many different ways.

**ML Machine Learning**
Machine Learning aims to develop algorithms that improve automatically through experience. It is a rapidly growing field, which has numerous applications, due to the availability of large datasets and the growth of computing power. The department at POSTECH focuses on both theoretical and practical aspects of machine learning.

**TC Theory of Computation**
Theory of Computation aims to understand the nature of computation and analyze fundamental computational problems arising in other fields in Computer Science using mathematical tools. It covers a wide variety of topics including algorithms, data structures, and computational complexity.
Research Overview

Our ultimate goal is to build AI models for more human-like and robust visual perception. To this end, we study fundamental visual recognition problems like classification, detection, segmentation, and retrieval of visual data, and also explore relevant areas of machine learning including deep learning, metric learning, and representation learning. In particular, our team is focusing on developing AI that is capable of learning visual perception for itself, using less or no human supervision. Examples include AI models teaching others by generating supervisory signals from a tiny hint, and those discovering and learning from common patterns of visual data. We are also interested in developing recognition models that are robust against extreme conditions and secure from malicious attacks on image acquisition processes.

Research Areas

- Computer Vision
- Machine Learning

Major Achievements

- Learning Using Less Supervision for Visual Recognition
- Deep Metric Learning for Image Retrieval
- Visual Recognition in Extreme Conditions
- Human Action Recognition
- Video Event Detection

Honors and Awards

- POSTECH CSE Young Scholar Award, 2020
- Editorial Board Member, IUCV, 2020
- Area Chair, ICCV, 2019
- Kakao Faculty Fellowship, 2018
- Samsung Humantech Paper Award, Bronze Prize, 2018
- CoView Challenge 1st place, ACMMM, 2018
- Best Reviewer Awards, NeurIPS, 2018
- Best Reviewer Awards, CVPR, 2018

Recent Publications

- Heeseung Kwon, Manjin Kim, Suha Kwak, and Minsu Cho, "MotionSqueeze: Neural Motion Feature Learning for Video Understanding", ECCV 2020
- Sungyeon Kim, Minkyo Seo, Ivan Laptev, Minsu Cho, and Suha Kwak, "Deep Metric Learning Beyond Binary Supervision", CVPR 2019 (Oral)
- Jiwoon Ahn, Sunghyun Cho, and Suha Kwak, "Weakly Supervised Learning of Instance Segmentation with Inter-pixel Relations", CVPR 2019 (Oral)
- Woong-Gi Chang, Tackgeun You, Seonguk Seo, Suha Kwak, and Bohyung Han, "Domain Specific Batch Normalization for Unsupervised Domain Adaptation", CVPR 2019
- Seunghoon Hong, Donghun Yeo, Suha Kwak, Honglak Lee, and Bohyung Han, "Weakly Supervised Semantic Segmentation Using Web-Crawled Videos", CVPR 2017 (Spotlight)
Recent advancements in the data-driven computing paradigm such as machine learning and big data are posing huge challenges to computer systems as they demand increasingly high computing power and memory capacity. As technology scaling slows down, significant improvements in the performance and cost-effectiveness of computer systems have to be provided through architectural innovations to meet the high demand from future applications.

Our research group focuses on innovating architectural designs of the systems to address such challenges. Current on-going projects in our group include co-designing deep learning algorithms and hardware accelerators to improve the efficiency of performing computer vision tasks, and designing a hybrid main memory system that consists of not only DRAM but upcoming Storage Class Memory to overcome the limitation of current memory systems.

**Research Overview**

Recent advancements in the data-driven computing paradigm such as machine learning and big data are posing huge challenges to computer systems as they demand increasingly high computing power and memory capacity. As technology scaling slows down, significant improvements in the performance and cost-effectiveness of computer systems have to be provided through architectural innovations to meet the high demand from future applications.

Our research group focuses on innovating architectural designs of the systems to address such challenges. Current on-going projects in our group include co-designing deep learning algorithms and hardware accelerators to improve the efficiency of performing computer vision tasks, and designing a hybrid main memory system that consists of not only DRAM but upcoming Storage Class Memory to overcome the limitation of current memory systems.

**Research Areas**

- Computer Architecture
- Parallel Computing
- Hardware Acceleration
- Memory System
- Interconnection Network

**Major Achievements**

- Pioneering memory-centric system interconnect
- Designing scalable, high-performance GPU system based on memory-centric network
- Designing transparent and standardizable near-data processing architecture
- Developing techniques for power and congestion management in large-scale interconnection network

**Honors and Awards**

- Best Invention Award for Industry-Academia Cooperation Projects (SK Hynix, 2014)
- Best Paper Award (The 22nd International Conference on Parallel Architectures and Compilation Techniques, 2013)

**Recent Publications**

- TCEP: Traffic Consolidation for Energy-Proportional High-Radix Networks, G. Kim et al., In proceedings of ISCA’18
- Toward Standardized Near-Data Processing with Unrestricted Data Placement for GPUs, G. Kim et al., In proceedings of SC’17
- History-Based Arbitration for Fairness in Processor-Interconnect of NUMA Servers, W. Song et al., In proceedings of ASPLOS’17
- Contention-based Congestion Management in Large-Scale Networks, G. Kim et al., In proceedings of MICRO’16
- Automatically Exploiting Implicit Pipeline Parallelism from Multiple Dependent Kernels for GPUs, G. Kim, et al., In proceedings of PACT’16
- Accelerating Linked-list Traversal through Near-Data Processing, B. Hong et al., In proceedings of PACT’16
- Transparent Offloading and Mapping (TOM): Enabling Programmer-Transparent Near-Data Processing in GPU Systems, K. Hsieh et al., In proceedings of ISCA’16
- iPAWS: Instruction-Issue Pattern-based Adaptive Warp Scheduling for GPGPUs, M. Lee et al., In proceedings of HPCA’16
- Overcoming Far-end Congestion in Large-Scale Networks, J. Won et al., In proceedings of HPCA’15

**Contact**

- Phone: +82-54-279-2260
- E-mail: g.kim@postech.ac.kr
- Homepage (lab): acp.postech.ac.kr

**Education**

- Ph.D.: KAIST (2016)
- M.S.: KAIST (2012)
- B.S.: POSTECH (2010)

**Career**

- 2016-2018: Senior Performance Engineer, Arm Inc
- 2018-Present: Assistant Professor, POSTECH
The goal of Intelligent Media Lab. is to study and develop a variety of intelligent systems with human-like intelligence. For doing this, we are focused on studying several basic techniques such as 1) Digital Image and Video Processing, 2) Pattern Recognition, 3) Computer Vision, 4) Computational Intelligence, 5) Machine Learning, 6) Deep Learning and 7) Graphical Models. Based on these basic techniques, we are developing a variety of algorithms for 1) Face Analysis (Face Detection, Eye Detection, Facial Feature Detection, etc), 2) Human Analysis (Pedestrian Detection, Human Pose Estimation, etc), 3) Video Analysis (Visual Surveillance System, Object Recognition, etc), and 4) ADAS (Traffic sign, Traffic light, Vehicle detection/ recognition, etc).

The developed algorithms are applied to many applications such as Smart Phones/TVs/Glasses, Intelligent UI/UX, Human Computer Interaction/Human Robot Interaction, Video Surveillance/Security, Intelligent Vehicles/Safety Cars, Robotics, and many others.

Research Areas
- Face Analysis
- Computer (Machine) Vision
- Intelligent Systems
- Autonomous Vehicle
- Advanced Driver Assistance Systems

Major Achievements
- Real-time Face Analyzer
- Face/Gaze/Facial Expression/Gesture Recognition System
- Visual Interface for Intelligent HRI, HMI, and HVI
- Gesture-based Multi-Spatial Touch Interface for Smart Phones or Smart TV

Honors and Awards
- 2019, CVPR Biometrics Workshop, Best Paper Award
- 2017, The 14th International Conference on Ubiquitous Robots and Ambient Intelligence, Best Application Paper
- 2015, ICDAR Document Recognition Challenge 1st place
- 2015, ICIP, Official Best 10% Seletion Certificate
- 2011, Hyundai NGV Excellent Industry-Academy Award
A vast amount of information is digitized and stored into various forms. Despite the collaborative effort to organize the information into structuralized forms, a large body of the stored information still remains in unstructured forms such as text and images. I structuralize the unstructured data by inferring hidden structures which cannot be directly observed from the data. In my research approach, I aim to infer the hidden structure of data by 1) extracting a common sub-structures that have been frequently appeared throughout the data 2) defining a latent variable model based on a plausible generative process of the data.

Recent Publications

We are getting a better life due to many continuously improving IT devices and systems that help our living. At the same time, we are also experiencing security problems of these IT devices and systems. We investigate security issues related to IT systems in three areas. 1) We study on mobile system security. Smartphones have become one of the most valuable attack targets due to its popularity. Most mobile malware aims to steal a huge amount of sensitive user data kept in smartphones, e.g., emails, contacts, and photos. Therefore, we study on developing effective solutions to protect such private data from attackers. 2) We study on AI/ML security. Recently, many IT applications are able to go beyond previous hurdles using AI/ML algorithms. These algorithms also become targets of security attacks. We study on attacks and defense methods of AI/ML algorithms. 3) We study on IoT security. There are many deployed and deploying IoT devices. These devices can be compromised by attackers and can be used to threaten our daily life and leak private information. We are working on detecting and preventing these security attacks.
Our research goal is to build a deductive verification system based on separation logic that can be applied to verifying real-world programs. On the theoretical side, we are refining the proof theory for separation logic which is the basis for our deductive verification system. On the practical side, we are building a verification system that covers both C programs and Java programs.

Recent Publications


Research Areas

- Separation logic
- Type theory
- Logic in computer science

Major Achievements

- A Proof System for Separation Logic with Magic Wand
- A Theorem Prover for Boolean BI
- Judgmental Subtyping Systems with Intersection Types and Modal Types
- Contractive Signatures with Recursive Types, Type Parameters, and Abstract Types
Research Overview

My research goal is to develop an advanced intelligent system that understands the geometric structure of real-world scenes and objects. In this regard, a super-fast geometric feature description, efficient point set registration, and 3D convolution operation have been my main research topics. In addition, I have been worked on various computer vision problems that include human understanding and image/video enhancement. I am one of the founding members of Open3D that is made to provide a free and easy-to-use tool for 3D data processing and visualization.

Research Areas

- Computer vision
- 3D Reconstruction
- Geometric structure understanding
- Shape generation
- Image and video enhancement

Major Achievements

- Introduced a geometric features extraction algorithm that is 600 times faster and more accurate than state-of-the-art
- Tangent convolution for large scale scene understanding
- Released Open3D library for 3D data processing
  - it receives 2.5K Github stars, and it is widely adopted in many companies and institutions worldwide
- Introduced a fast point set registration technique
  - taken as a baseline approach in NASA Mars Pathfinder simulator

Honors and Awards

- Senior Program Committee, AAAI, 2021
- Area Chair, CVPR 2020, 2021
- Session Chair, Area Chair, ICCV, 2019
- Google Season of Docs, 2019
- Intel Research Velocity Challenge Award, 2018
- KAIST-Qualcomm Innovation Award, 2015, 2016
- HumanTech Paper Award Silver Prize, 2013, 2014
- Microsoft Research Asia Fellowship, 2011
- KFAS Scholarship, 2009

Recent Publications

- Contrastive Generative Adversarial Networks, NeurIPS 2020
- A Large Multiview Dataset of Human Body Expressions, CVPR 2020
- ConvNets for Geometric Pattern Recognition, CVPR 2020
- Future Video Synthesis, CVPR 2020
- Fully Convolutional Geometric Features, ICCV 2019
- Depth from a Light Field Image, TPAMI 2019
- Tangent Convolutions for Dense Prediction in 3D, CVPR 2018
- Open3D: A Modern Library for 3D Data Processing, Arxiv 2018
- Colored Point Cloud Registration Revisited, ICCV 2017
- Tanks and Temples, SIGGRAPH 2017
- Robust Multiview Photometric Stereo, TPAMI 2016
- Fast Global Registration, ECCV 2016
Prof. Chanik Park 박찬익 교수

Contact
- Phone +82-54-279-2248
- E-mail cipark@postech.ac.kr

Education
- Ph.D. KAIST (1988)
- M.S. KAIST (1985)
- B.S. Seoul National University (1983)

Career
  Editorial Board Member - Korea Information Science Society, Korea
- 2005.3-2012.8
  Board Member - Institute of Embedded Engineering of Korea, Korea
- 2007.3-Present
  Vice President, Board Member - Korea Institute of Next-Generation Computing
- 2010.9-2013.8
  Dean of Academic Information Affairs - POSTECH, Pohang, Korea
- 2015.9-2016.8
  Visiting Scholar - Yale University, New Haven, CT

Research Overview
The main research areas include reliable storage systems, trusted computing, and embedded Linux. Recently, we are focusing on blockchain technology which requires in-depth experience and knowledge in system software. Blockchain scalability, privacy, and security are listed in our current research projects. In addition, we are interested in mobile system security which is critical for blockchain wallets. It is important to support trusted execution environment (TEE) in mobile embedded devices for secure computing and data protection. We are trying to realize TEE on embedded devices without special hardware features.

Research Areas
- Storage systems
- Trusted computing, system virtualization
- Embedded Linux, Internet of Things
- Blockchain

Major Achievements
- Toward Trustworthy Blockchain-as-a-Service with Auditing
- Design of Extensible Non-Fungible Token Model in Hyperledger Fabric
- SofTEE : Realizing Software-only TEE with Kernel Deprivileging
- Delegated Byzantine Fault Tolerance using Trusted Execution Environment
- Redesigning Hyperledger Fabric Blockchain with Append-only Ledger

Honors and Awards
- 2018, Silver Prize, LINExKIISE Blockchain Contest
- 2015, CISC-W, Best Paper Award
- 2013, IEMEK, Excellent Presentation Award
- 2013, KCC Best Paper Award
- 2013, Encouragement Prize, Samsung Humantech Paper Contest

Recent Publications
- Yongrae Jo, Jeonghyun Ma and Chanik Park, "Toward Trustworthy Blockchain-as-a-Service with Auditing", 40th IEEE International Conference on Distributed Computing Systems, July 8 - 10, 2020, Singapore (To appear)
- Sejin Park and Chanik Park, "FRD: A Filtering based Buffer Cache Algorithm that Considers both Frequency and Reuse Distance", MSST 2017

Blockchain based User Authentication
Auditing Blockchain Platform
System Security with TEE
Software is everywhere, but it can be buggy and unpredictable. The goal of our research group is to develop novel and automated techniques to ensure the reliability, security, and safety of software systems. In particular, cyber-physical systems, such as self-driving cars and drones, must meet strong safety requirements. Errors or bugs in such systems can result in enormous damage, even human deaths. Our group is developing model checking algorithms and tools for verifying the safety requirements of cyber-physical systems, based on automated reasoning algorithms. Our techniques can automatically verify complex logical properties, specified in signal temporal logic, of cyber-physical systems.

Research Areas

- Software Verification
- Automated Reasoning
- Formal Methods
- Automated Software Engineering
- Computational Logic

Major Achievements

- Model checking algorithms of signal temporal logic properties for cyber-physical systems
- Symbolic model checking algorithms for concurrent systems specified in rewriting logic
- Formal analysis techniques of virtually synchronous cyber-physical systems

Honors and Awards

- Best Paper Award, FACS (2017)
- Feng Chen Memorial Award, UIUC (2013)
- Chirag Foundation Fellowship, UIUC (2007)
Research Overview

Mobile Networking lab. focuses on research in the area of IoT and artificial intelligence. Our research interests include i) activity recognition using machine learning, ii) localization, tracking and location-based service (ex: indoor positioning system), iii) protocol design for WLAN, WPAN, LPWAN, localization, iv) full-duplex radio communication, etc. Recently, we are interested in the application of artificial intelligence technology (machine learning) to study network performance improvement, gesture detection without camera, IoT application development.

Recent Publications


Wireless LAN MAC for Multicast and Full-duplex Communication

Indoor Localization and Navigation Application
The goal of my research is to design complexity- and performance-efficient SW/HW interfaces systematically by leveraging software-level information and applying machine-learning techniques.

The key insight is that leveraging higher-level information in design and optimization processes for system components, including compilers, execution runtime, and architectures, leads to a much more powerful and often simpler solution. My past and ongoing work includes energy-efficient memory system and cache coherence protocol design, deep-learning based resource management solutions, and compiler and runtime support for high-level parallel programming models on heterogeneous systems.

### Research Areas
- Computer architectures
- Memory systems
- Compiler and runtime design
- Machine learning for system optimizations
- Systems for machine learning

### Major Achievements
- DeNovo: Energy-efficient memory system hierarchy
- CORAL: Compiler and runtime support for OpenMP with offloading directives for exascale computing
- CogR: Deep-learning based runtime scheduling solution
- Parallelizing compilers for massively parallel tiled architectures

### Honors and Awards
- Andres and Shana Laursen Fellowship, 2014-15
- W. J. PoppeBaun Memorial Award, 2014
- IEEE Micro Top Picks from the Computer Architecture Conferences, 2014
- Best paper award in PACT, 2011
- The Feng Chen Memorial Award, 2011 and 2014

### Recent Publications
- CogR: Exploiting Program Structures for Machine-Learning Based Runtime Solutions, PACT 2019 (poster)
- Efficient Fork-Join on GPU’s Through Warp Specialization, HiPC 2017
- Automatic Copying of Pointer-Based Data Structures, LCPC 2016
- Supporting Arbitrary Synchronization without Writer-Initiated Invalidations, ASPLOS 2015
- DeNovoND: Efficient Hardware Support for Disciplined Non-Determinism, ASPLOS 2013
Research Overview

We are aiming to research and develop innovative media computing & networking technologies for advanced media services including video streaming, 3D game, 360 VR (virtual reality) video, and AR (augmented reality), etc. Our research interest includes media computing, multimedia networking, and wireless/wired networks necessary to effectively support real-time advanced media applications.

Research Areas

- Future Internet/Network
- Image/Video Communication System/Multimedia Signal Processing
- Harmonization of Heterogeneous Wireless Networks
- Multimedia Networking
- Quality-of-Service/Quality-of-Experience over Wireless/Wired Networks
- P2P Network
- IPTV/Mobile IPTV
- Ad-Hoc Network, Sensor Network

Major Achievements

- Game-theoretic scalable offloading system over WiFi and LTE networks
- Reliable and Energy efficient hybrid screen mirroring multicast system
- 3D rendering and streaming for interactive online game
- Multipath transport protocol
- Rate Control Algorithms for Video Communication
- Multimedia Caching Algorithms
- Mobile IPTV/IPTV Channel Control Algorithms
- P2P Overlay Video Multicast System
- Cross Layer Optimized Video Streaming over multi-hop Mobile Ad Hoc Networks
- Jointly Optimized Call Admission Control/Routing/Scheduling/Power Control

Honors and Awards

- Silver Prize at the 20th Samsung Humantech Paper Award
- Workshops Best Paper Award at IEEE SDS & FMEC, 2018

Recent Publications

- Hyunmin Noh and Hwangjun Song, "Progressive caching system for video streaming services over Content Centric Network," IEEE Access, April, 2019.
Research Overview

Computational geometry is the study of design and analysis of algorithms dealing with geometric objects. Therefore the goal of research is to develop efficient algorithms and data structures for solving problems stated in terms of basic geometrical objects, such as points, line segments, polygons, polyhedra, etc.

It emerged as a sub-discipline of theoretical computer science from 1970s, and has grown into a recognized research discipline in computer science and applied mathematics, with a large community of active researchers. It had developed in several directions and forged links with other application domains such as computer aided design, robotics, computer graphics, virtual reality, computer vision, bio-informatics, and geographic information system.

We believe that knowledge of computational geometry is important to solve geometric problems in application areas efficiently.

Research Areas

- Computational and Discrete Geometry
- Algorithms
- Data Structures
- Theory of Computation

Major Achievements

- 2D/3D Geometric Shape Matching Algorithms
- Geometric Shape Approximation
- Geometric Algorithms for Manufacturing (Casting Process)
- Design and Implementation of Networked Virtual Environments Based on PC Cluster.

Honors and Awards

- Best Paper Award at 11th SSTD (2009)
- Excellent Paper/Presentation Award at KIESE/KCC Conferences (2011/2012/2013/2015)
- POSTECH Education Award (2017)
- Mueunjae Chair Professor (2019-2021)
Research Overview

My research focuses on designing efficient algorithms for various geometric problems. Specifically, I have been working on the following three topics: (1) dynamic point location problems, (2) shortest path problems in the presence of obstacles and (3) range searching problems. All of the three problems have been studied for the last several decades, yet many algorithmic problems in these fields still remain unsolved. I have worked on challenging open problems in these fields and resolved several long-standing open problems. More specifically, I presented an optimal algorithm for computing the Voronoi diagram in a simple polygon, and a dynamic data structure supporting point location queries and updates in sublinear times. I am currently focusing on developing general techniques and tools which can be universally applied to various geometric problems as well as studying challenging open problems.

Research Areas

- Computational and Discrete Geometry
- Data Structures and Algorithms
- Theory of Computation

Major Achievements

- Shortest Paths in the Euclidean Space with Opstacles
- Data Structures for Clusterings
- Data Structures for Point Location

Honors and Awards

- Lisa Meitner Fellowship, MPI for Informatics

Recent Publications

- Optimal Algorithm for Geodesic Nearest-Point Voronoi Diagrams in Simple Polygons (SODA2019)
- Approximate Range Queries for Clustering (SoCG2018)
- Point Location in Dynamic Subdivisions (SoCG2018)
- Voronoi Diagrams for a Moderate-Sized Point-Set in a Simple Polygon (Discrete and Computational Geometry)
- A New Balanced Subdivision of a Simple Polygon for Time-Space Trade-Off Algorithms (Algorithmica)
Jungseul Ok is an assistant professor in the Department of Computer Science and Engineering and Graduate School of Artificial Intelligence, and a member of Machine Learning Lab at POSTECH. He completed Ph.D program in School of Electrical Engineering at Korea Advanced Institute of Science and Technology (KAIST), South Korea, under the supervision of Prof. Yung Yi and Prof. Jinwoo Shin. After graduation, he worked with Prof. Alexandre Proutiere and Prof. Sewoong Oh as a postdoctoral researcher, respectively, in School of Electrical Engineering at KTH, Stockholm, Sweden, and Paul G. Allen School of Computer Science & Engineering, University of Washington, WA, US. His research focus is theoretical machine learning on a wide spectrum of topics, including neural network analysis, Markov decision process, structured reinforcement learning, recommender system, wireless network, social network, crowdsourcing system, and influence maximization.

**Research Areas**
- Reinforcement Learning
- Machine Learning
- Computational Social Science
- Neural Network Analysis

**Major Achievements**
- Fundamental limit and optimal algorithm in structured reinforcement learning problem
- Optimal estimation for classification and regression in crowdsourced dataset

**Honors and Awards**
- Qualcomm-KAIST Innovation Award, Qualcomm, 2016
- Nomination Award, Fellowships at Microsoft Research Asia, 2015
- Summa Cum Laude Honor, KAIST, 2011

**Recent Publications**
- Jungseul Ok, Sewoong Oh, Yunhun Jang, Jinwoo Shin, and Yung Yi, "Efficient Learning for Crowdsourced Regression", AISTATS, 2019
- Jungseul Ok, Alexandre Proutiere, and Damianos Tranos, "Exploration in Structured Reinforcement Learning", NeurIPS, 2018 (full oral)
- Weiran Huang, Jungseul Ok, Liang Li, Wei Chen "Combinatorial Pure Exploration with Continuous and Separable Reward Functions and Its Applications", IJCAI, 2018
- Jungseul Ok, Se-Young Yun, Alexandre Proutiere, and Rami Mochaourab, "Collaborative Clustering: Sample complexity and Efficient Algorithms", ALT, 2017
- Jungseul Ok, Jinwoo Shin, and Yung Yi , "Incentivizing Strategic Users for Social Diffusion: Quantity or Quality?", IEEE INFOCOM, 2017 [slide]
- Jungseul Ok, Sewoong Oh, Jinwoo Shin and Yung Yi, "Optimality of Belief Propagation for Crowdsourced Classification", ICML, 2016
What is Big Data (or data mining)? It is a study about extracting value from data. Data is everywhere, heterogeneous, and continuously increasing. For example, rapidly growing is the Internet, data warehouses, biological data, or scientific data. Rich data but poor information is a common phenomenon in real world. Big Data has been chosen as the top 10 crucial technology that would change the world! Big Data is an interdisciplinary field that involves databases, machine learning, statistics, algorithms, computer vision, and natural language processing.

Our current research interests reside in multi-modal learning, recommender system, anomaly detection, natural language processing, stream data mining, and scalable machine learning. We handle multiple types of data including tables, matrix, tensor, text, image, graph, and time-series.

**Research Areas**
- Big Data
- Data Mining
- Artificial Intelligence
- Machine Learning

**Major Achievements**
- Scalable Machine Learning
- Recommender System
- Privacy-Preserving Data Mining
- Positive Unlabeled (PU) learning
- Time-Series Data and Anomaly Detection

**Honors and Awards**
- 공학한림원이 선정한 “2025년 대한민국을 이끌 100대 기술 및 주역” (차세대 기계학습 분야)
- 네이버 젊은 석좌 교수, 카카오 석좌교수
- POSTECH URP 최우수 지도 교수
- IITP 소프트웨어 스타랩 선정
- 한국연구재단 우수 국가과제 선정

**Recent Publications**
- "Deep rating elicitation for new users in collaborative filtering", WWW 2020
- "Unsupervised attributed multiplex network embedding", AAAI 2020
- "Input initialization for inversion of neural networks using k-nearest neighbor approach", Information Sciences 2020
- "Scalable disk-based topic modeling for memory limited devices", Information Sciences 2020
- "Fast and memory-efficient algorithms for high-order tucker decomposition", KAIS 2020
- "OCAM: out-of-core coordinate descent algorithm for matrix completion", Information Sciences 2020
- "Adversarial approach to domain adaptation for reinforcement learning on dialog systems", Pattern Recognition Letters 2019
- "An encoder-decoder switch network for purchase prediction", Knowledge-Based Systems 2019
- "Target-aware convolutional neural network for target-level sentiment analysis", Information Sciences 2019
- "BHIN2vec: Balancing the type of relation in heterogeneous information network", CIKM 2019
- "Task-guided pair embedding in heterogeneous network", CIKM 2019
- "Semi-supervised learning for cross-domain recommendation to cold-start users", CIKM 2019
- "Sequential and diverse recommendation with long tail", IJCAI 2019
- "Action space learning for heterogeneous user behavior prediction", IJCAI 2019
Question answering is a study of finding the answer from natural language question. The answer can be found from text (CGQA), a collection of documents (IRQA), or structured graph (KBQA). Dialog system is a system that can interact with human in natural language. Multiple studies such as spoken language understanding (SLU), robust dialog management, multi-party dialog, multi-domain detection have been researched. We help human to learn language and speech through dialog and corrective feedback.

Research Areas

- Speech and Natural Language Processing (w/ Deep Learning)
- Spoken Dialog Systems
- Computer Assisted Language Learning
- Natural Language Question Answering

Major Achievements

- Unlimited Vocabulary TTS System (Korean, Chinese, English)
- Spoken Dialog System (Korean, English)
- Intelligent Dialog-based CALL System (English)
- English Speech Assessment and Assistant System (for Korean)
- Natural Language QA system (English, Korean)

Honors and Awards

- IR52 Jangyoungsi award, 2001
- IEEE SLT 2010 AT&T Best Student Paper Award, 2010 Dec

Recent Publications

- Seonghan Ryu et al., Out-of-domain Detection based on Generative Adversarial Network, EMNLP, 2018
- Sangjun Koo et al., Adversarial approach to domain adaptation for reinforcement learning on dialog systems, Pattern Recognition Letters, 2019
- Seonghan Ryu et al. Neural sentence embedding using only in-domain sentences for out-of-domain sentence detection in dialog systems, Pattern Recognition Letters, 2017

Contact

- Phone: +82-54-279-2254
- E-mail: gblee@postech.ac.kr
- Homepage (lab): http://nlp.postech.ac.kr/home/
Prof. Seungyong Lee

Contact
- Phone: +82-54-279-2245
- E-mail: leesy@postech.ac.kr
- Homepage (lab): http://cg.postech.ac.kr/

Education
- M.S.: KAIST (1990)
- B.S.: Seoul National University (1988)

Career
- 1996.10–Present: Professor, POSTECH
- 2010.9–2011.8: Visiting professor, Adobe Research
- 2003.8–2004.8: Visiting professor, MPI Informatik
- 1995.3–1996.9: Post-doctoral Researcher, CCNY/CUNY

Research Overview
My research goal is to develop algorithms and techniques useful for software and tools in various graphics applications. In terms of research topics, the current focuses are on image and video processing, 3D reconstruction, and face reconstruction, covering image restoration and enhancement, texture mapping for dense 3D reconstruction, and 2D/3D caricatures. In terms of research tools, recent deep learning methods, 3D scanning using RGBD sensors, problem-specific optimization frameworks are commonly used to find the best solutions. I enjoy finding simple but effective solutions that can be readily implemented and optimized for practical applications. I am also much interested in industrial deployments of my research results. My technologies on image deblurring and photo upright adjustment have been transferred to Adobe Creative Cloud and Adobe Photoshop Lightroom.

Research Areas
- Computer Graphics & Image Processing
- Deep learning based computational photography
- 3D object/scene reconstruction
- 3D face reconstruction

Major Achievements
- Image and video deblurring
- Stylized rendition of 2D images and 3D models
- Photo and 360 image upright adjustment
- Texture mapping for 3D reconstruction
- 2D/3D caricature generation

Honors and Awards
- Computer Graphics Grand Award, KCGS, 2018
- Gahun Academic Award, KIISE, 2014
- Best Paper Awards, Pacific Graphics 2014, 2019
- Best Kinect-Application Award, ACCV, 2012
- Commendation, MCST, 2011
- Best Science and Engineering Paper Award, KOFST, 2011

Recent Publications
We’ve been investigating various research topics on language-related tasks, including natural language processing (NLP), machine translation (MT), information retrieval (IR), and text mining (TM). Recently more attention has been put on the study of automatic post-editing and quality estimation for MT, and also on its other applications like grammatical error correction and phrase generation, achieving the world-top performance. Abstractive text summarization and dialogue system are studied as well for commercialization.

**Research Areas**

- Deep Learning for NLP, MT, & IR
- MT (Machine Translation)
  - Quality Estimation, Automatic Post-Editing
  - Multimodal MT
- Text Summarization
- Dialogue System

**Major Achievements**

- WMT18 Quality Estimation Task (1st rank)
- WMT19 Automatic Post-Editing Task (2nd rank)
- Abstractive Summarization (SOTA performance, 2019)
- Risk Simulator for Patent Infringement (POSCO, 2015)
- Translator of Korean into Korean Sign Language (Samsung Electronics, 2014)
- TREC 2010, 2009, 2008 Blog Track (1st & 2nd rank)

**Honors and Awards**

- Gold Prize for Excellence in Technology (by POSCO, Korea, 1997)
My research lies in the areas of computer vision and machine learning, especially in the problems of visual semantic correspondence, graph-based image matching, object discovery and localization, video action recognition, and learning with minimal supervision. In general, I am interested in the relationship between correspondence and supervision in visual learning. Visual correspondence is at the heart of image and video understanding with a wide range of applications including object recognition, retrieval, and 3D reconstruction. While there has been significant progress in learning robust feature representation for classification, establishing correspondence between images or videos in the wild still remains an extremely challenging problem. In our group, we investigate dynamic neural composition models for relational problems in computer vision, which composes effective features by leveraging relevant neural layers or streams conditioned on input on the fly. We also develop weakly-supervised or unsupervised learning frameworks for these problems, which require a minimal degree of human supervision in training the models.

### Research Areas

- Computer Vision
- Machine Learning

### Major Achievements

- Visual semantic correspondence and matching
- Unsupervised object discovery and representation learning
- Action recognition and video understanding
- Weakly-supervised learning for object recognition
- Relational knowledge transfer and distillation
- Meta-learning for matching and tracking

### Honors and Awards

- 2019 Proud POSTECHIAN Award in education
- ICCV 2019 CoView workshop challenge, 2nd place winner
- ACM Multimedia CoView workshop challenge, 1st place winner
- MSRA 2018 Collaborative Research Grant Awards
- IICV Associate Editor (2019-), PRL Guest Editor (2018)
- CVPR ’18, ’20, ’21, ICCV ’19, WACV’18, ACCV’18, ICPR’20 Area Chair
- ICCV’19, ACM MM’18 Web Chair

### Recent Publications

- Juhong Min, Jongmin Lee, Lee Ponce, Minsu Cho, Hyperpixel Flow: Semantic Correspondence with Multi-layer Neural Features, ICCV 2019
- Wonpyo Park, Dongju Kim, Yan Lu, Minsu Cho, Relational Knowledge Distillation, CVPR 2019
- Huy V. Vo, F. Bach, Minsu Cho, Kai Han, Yann LeCun, Patrick Pérez, Jean Ponce, Unsupervised Image Matching and Object Discovery as Optimization, CVPR 2019
- Paul Hongsuck Seo, Jongmin Lee, Deunsol Jung, Bohyung Han, Minsu Cho, Attentive Semantic Alignment with Offset-Aware Correlation Kernels, ECCV 2018
Research Overview

The primary goal of the research in our lab is to develop intelligent algorithms that can help create and enhance visual contents including images and videos. To this end, we study various research problems ranging from image restoration problems such as image denoising, super-resolution, deblurring to graphics applications such as image synthesis, inpainting and interactive navigation of 360 videos. We are also actively working on developing deep learning algorithms to create more intelligent solutions to those problems.

Research Areas

- Computational photography
- Image/video processing
- Computer graphics
- Computer vision

Major Achievements

- Image and video deblurring
- Learning-based image restoration
- Tech transfer to Adobe Photoshop CC

Honors and Awards

- Pacific Graphics 2019 Best Paper Award
- IPIU 2019 Best Paper Award (Silver, Bronze, Best Poster Paper Awards)
- KSC 2018 Best Paper Award (Silver Award)
- KCGS 2018 Best Poster Award
- KCGS 2017 Best Poster Award
- Outstanding Reviewer for CVPR, 2013, 2017
- Korea Computer Graphics Society 2011 Young Researcher Award Nominee
- HCI 2009 Best Paper Award
- Microsoft Research Asia 2008/09 Graduate Research Fellowship

Recent Publications

- Jiwoon Ahn, Sunghyun Cho, Suha Kwak, Weakly Supervised Learning of Instance Segmentation with Inter-pixel Relations, CVPR 2019
- Jucheol Won, Sunghyun Cho, Video Upright Adjustment and Stabilization, BMVC 2019
- Zhe Hu, Sunghyun Cho, Jue Wang, Ming-Hsuan Yang, Deblurring Low-light Images with Light Streaks, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 40, no. 10, 2018
My research centers around finding and designing easy, effective, and novel interaction methods between human users and a system of interest, which can be any of computers, robots, electronic device, and cars, to name a few. Emphasis is on physical interaction where the human somatosensory system has the predominant role for interaction. Current research topics include understanding and automatic synthesis of motion effects for 4D films and VR games, multimodal and data-driven haptic rendering for improved realism, vibrotactile perception and rendering, and perception and rendering of haptic effects using a variable friction display.

Research Areas

- Haptics
- Virtual Reality, Human-Computer Interaction, and Robotics
- Applied Perception

Major Achievements

- Authoring and Synthesis of Haptic Content
- Vibrotactile Rendering and Perception
- Data-driven Haptic Rendering
- Automatic Synthesis of Motion Effects for VR

Honors and Awards

- 2011, Early Career Award, IEEE Technical Committee on Haptics
- 2014, Citation for Meritorious Service (Associate Editor), IEEE Transactions on Haptics
- 2017, Best Poster Paper Award, IEEE World Haptics Conference
- 2010, Best Demonstration Award, IEEE Haptics Symposium
- 2009, Best Student Paper Award, IEEE World Haptics Conference

Recent Publications

- Sunung Mun, Hojin Lee, and Seungmoon Choi, "Perceptual Space of Regular Homogeneous Haptic Textures Rendered Using Electrovibration," In Proceedings of the IEEE World Haptics Conference (WHC), pp. 7-12, July 9-12, 2019 (Oral presentation; Acceptance rate 5.7%; Finalist for the Best Paper Award).
Research Overview
We have been focusing on big data, databases, mining, and AI related research.
Our goal is to build scalable, intelligent Big data systems that effectively and efficiently deal with Big data. Most of Big data is unstructured data, and thus, it is difficult to handle. We are building a system for converting unstructured data into semi-structured data in a graph form so that it can be easily handled in our parallel graph engine. We are also building an intelligent system to interact with humans.

Research Areas
- Natural Language Interface to Database (NLIDB)
- Large-scale Video Query Processing
- Parallel Computation System for Big Data Analysis on Modern Hardware
- Large-scale Graph Computation System
- Intelligent Computation Systems for Structured and Dark Data

Major Achievements
- Ultrafast Graph Analytics Engines for Trillion-scale Graphs
- Frameworks for Graph Pattern Matching
- Parallelizing Query Optimization Exploiting the Multi-core Architecture
- Progressive Query Optimization in a Shared Nothing Parallel DBMS (inside IBM DB2)
- Tight Integration of Database and Information Retrieval

Honors and Awards
- Scientist of the Month Award, Ministry of Science, ICT and Future Planning, August, 2016
- Oracle External Research Office Award (unrestricted gift: $580,000), 2014–2020
- VLDB 2010, selected as best of VLDB, 2010 (IGraph paper)
- ACM CIKM Distinguished Service Award, 2009
- Best Demonstration Award, IEEE Int'l Conf on Data Engineering (ICDE), April 2005
- Performance Evaluation of TurboFlux
- Performance Evaluation of TurboGraph++

Recent Publications
- Kim, K., Seo, I., Han, W., Lee, J., Hong, S., Chafi, H., Shin, H., and Jeong, G., "TurboFlux: A Fast Continuous Subgraph Matching System for Streaming Graph Data," In ACM SIGMOD, 411-426, 2018. (Corresponding author)
- Ko, S., and Han, W., "TurboGraph++: A Scalable and Fast Graph Analytics System," In ACM SIGMOD, 395-410, 2018. (Corresponding author)
- Kim, H., Lee, J., Bhowmick, S., Han, W., Lee, J., Ko, S., and Jarrah, M., "DualSim: Parallel Subgraph Enumeration in a Massive Graph on a Single Machine," In ACM SIGMOD, 1231–1245, 2016. (Corresponding author)
DPNM has been focusing on 1) network management, 2) blockchain and cryptocurrency, and 3) applying AI technology in network management and blockchain/cryptocurrency. Network softwareization paradigms such as SDN and NFV provide network operators with various advantages. However, to fully reap these benefits and cope with challenges regarding the heterogeneity of user demands, the operation and management of such networks require a high degree of automation that ensures fast and proactive decision making. For the goals, we are working on the development of virtual network management technology based on artificial intelligence.

We are also working on advancing blockchain technology and applying it to solve real-world problems. Working on various aspects of cryptocurrency has also been the recent focus of DPNM Lab.

### Research Overview

- AI & BigData for SDN/NFV and Blockchain
- Software-Defined Networking (SDN)
- Network Function Virtualization (NFV)
- Blockchain & Cryptocurrency
- Network Traffic Monitoring and Analysis
- Video Conference Systems (Vmeeting)

### Research Areas

- AI & BigData for SDN/NFV and Blockchain
- Software-Defined Networking (SDN)
- Network Function Virtualization (NFV)
- Blockchain & Cryptocurrency
- Network Traffic Monitoring and Analysis
- Video Conference Systems (Vmeeting)

### Major Achievements

- Virtual Network Management Technology based on Artificial Intelligence
- Blockchain Transaction Monitoring and Analysis Technology
- Core Technologies for Programmable Switch in Multi-Service Networks
- Inband Network Telemetry for Open Network OS
- Open Source Project Contribution (ONOS & CORD)

### Honors and Awards

- 2017, Flipped Learning excellence award of POSTECH
- 2016, Citation of the Minister of Science, ICT and Future Planning
- 2016, Gold award & Special prize of K-ICT Net Challenge Camp
- 2013, Dan Stokesberry Award
- Best Paper Awards - NetSoft 2015
Research Overview

Deep learning-based algorithms show excellent performance in various fields such as image processing, natural language recognition, and recommendation system. However, their utilization is limited due to realistic constraints, e.g., computation cost, power restriction, and delayed latency. Our goal is to maximize the usage of deep learning-based algorithms by easing the constraints through HW/SW co-design and optimization. We focus on developing advanced optimization algorithms, e.g., quantization, pruning, and architecture search, to eliminate the redundancy of deep neural networks. In addition, we try to design a specialized hardware accelerator to maximize the benefit of the optimization methods. Eventually, our team aims to automate system optimization so that everyone can enjoy the benefits of optimization.

Recent Publications

- Towards Sub-4-bit Quantization of Optimized Mobile Networks, Eunhyeok Park, Sungjoo Yoo, European Conference on Computer Vision (ECCV), Spotlight, 2020
- McDRAM v2: In-Dynamic Random Access Memory Systolic Array Accelerator to Address the Large Model Problem in Deep Neural Networks on the Edge, Seunghwan Cho, Haerang Choi, Eunhyeok Park, Hyunsung Shin, Sungjoo Yoo, IEEE Access, 2020
- Value-Aware Quantization for Training and Inference of Neural Networks, Eunhyeok Park, Sungjoo Yoo, Peter Vajda, European Conference on Computer Vision (ECCV), 2018
- Energy-efficient Neural Network Accelerator Based on Outlier-aware Low-precision Computation, Eunhyeok Park, Dongyoung Kim, Sungjoo Yoo, International Conference on Computer Architecture (ISCA), 2018

Research Areas

- Deep Learning Optimization
- HW/SW co-design
- AutoML for Optimization

Major Achievements

- Sub-4-bit quantization for optimized mobile networks
- Specialized neural accelerator design with zero-skipping and low-precision computation
- Deploy deep learning applications on edge devices
- Optimized neural architecture design for vision tasks

Honors and Awards

- Naver Ph.D. Fellowship, 2017
- Best dissertation award, Seoul National University, Department of Computer Science and Engineering, 2020
Research Overview

Our mission is to create novel human-centered computing systems and applications to advance real-life human abilities and experiences, at the intersection of mobile & pervasive computing, human-computer interaction, and applied machine learning. In these areas, our research is an interdisciplinary ensemble of computing systems and real-life human factors, including physical, emotional, cognitive & social aspects. From systems perspective, we think-ahead, design, and optimize next-generation mobile/edge platforms to effectively and creatively serve newly emerging real life-driven computing workloads and user requirements. From applications & human-factor perspective, we are enthusiastic about disrupting our real-life problems by building, deploying, and evaluating first-of-a-kind computing applications in various domains of (but not limited to) health & wellbeing, family & childcare, aging & generational issues, and supporting underrepresented social groups.

Research Areas

- Mobile & Pervasive Computing
- Human-Computer Interaction
- Applied Machine Learning

Major Achievements

- Zero-effort Autonomous Robotic Telepresence System
- Wearable Pervasive Care Service for Language Development Disorder (feat. in NewScientist, 2014)

Honors and Awards

- Best Paper Award, ACM CSCW '14
- Best Demo Awards, ACM MobiSys ’19 & ’12
- Best Poster Runner-up, ACM HotMobile ’20
- Honorable Mention, ACM CHI ’14
- Distinguished TPC Member Awards, IEEE INFOCOM ’16-’20
- IBM Master Inventor (2016-)
- IBM Invention Achievement Awards: 1st-21st Plateau, ’15-’20

Recent Publications


(*: corresponding author)
Research Overview

Dr. Kim's research interests lie in interdisciplinary research across various topics in Machine Learning, Computer Vision and Medical Imaging. On the theoretical side, he is particularly interested in applied harmonic analysis in non-Euclidean spaces (e.g., signal processing on graphs) to develop novel methods for statistical analysis of images or image-derived measures. On the application side, he mainly focuses on analyses of biomedical data to facilitate understandings of neurodegenerative brain disorders such as Alzheimer's disease (AD) towards mechanisms for diagnosis, discovering new treatments and design of new studies.

Recent Publications


Research Areas

- Medical Imaging
- Machine Learning
- Computer Vision

Major Achievements

- Identifying regional changes in the brain with (preclinical) Alzheimer’s Disease (AD)
- Identifying changes in brain connectivity with AD
- Signal recovery (matrix completion) on graphs
- Generative model for longitudinal neuroimaging

Honors and Awards

- NSF IIS Research Initiation Initiative (CRII), NSF, 2020
- NSF CAREER Workshop Travel Award, NSF, 2019
- STARS Award, University of Texas System, 2017
- Machine Learning Summer School (MLSS) Scholarship, University of California, Santa Cruz, 2012
- 3rd Place in 12th Grade, Utah Math Contest, 2001