1 Contact Information

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2 Education

Ph.D., Mathematical Sciences March 2002 - February 2008

• Korea Advanced Institute of Science and Technology (KAIST), Deajeon, South Korea

- Thesis title: PDE-based image processing for segmentation and image restoration
- Advisor: Professor Chang-Ock Lee
- Area of Study: Image processing based on nonlinear PDEs, variational numerical methods, nonlinear optimization

- KAIST, Deajeon, South Korea
- Advisor: Jin Hwan Lim
- Area of Study: Riemannian geometry

- Department name changed from Applied Physics
- Inha University, Incheon, South Korea
- Second major: Mathematics

3 Professional Career

- Funding: SASPRO2 (Slovak Academic and Scientific Programme, Horizon 2020 Marie Skłodowska-Curie COFUND Action Programme)
- Hosting University: Department of Mathematics and Descriptive Geometry, Faculty of Civil Engineering, Slovak University of Technology, Radlinskeho 11, 810 05 Bratislava, Slovakia
- Principal Investigator: PhD Jooyoung Hahn
- Science in Charge: Professor Karol Mikula
- Topic: Numerical methods for computational evolving manifolds

• About Korea-Technology Advisory Group (K-TAG) Europe : K-TAG Europe launched by KIAT and MOTIE in July 2014, consists of Korean engineering experts in Europe. Main activities of K-TAG are (1) to assist Korean Small and Medium-sized Enterprises (SMEs) in finding European Innovative partners (2) to provide advice as well as information related to Korea-EU R&D cooperation (3) to develop and participate in Korea-EU joint R&D projects.

EUREKA/Eurostars: Technical expertJuly 2019 - Present

- Advanced Simulation Technologies, AVL, Graz, Austria
- Computational fluid dynamics in advanced simulation technologies

- The main numerical algorithm developer in finite volume method and particle-based method on polyhedral meshes:
 - G-equation (level set method) in combustion on polyhedral meshes.
 - Curve evolution for spark plug system (Particle movement controls in a complicated geometry).
 - Efficient surface-to-surface radiation.
 - Level set method with adaptive mesh refinement for multiphase flow.
 - Accurate gradient computations

• Complete Vehicle Energy Management Control Optimization (Level-Set Dynamic Programming)

• Institute for mathematics and scientific computing, University of Graz, Graz, Austria

- Advisor: Professor Michael Hintermüller
- A senior PostDoc in START Project: Interfaces and Free Boundaries

- Division of Mathematical Sciences, Nanyang Technological University, Singapore
- Advisor: Professor Xue-Cheng Tai
- A research staff in Mathematical Imaging and Vision Group

- Department of Mathematical Sciences KAIST, Deajeon, South Korea
- Advisor: Professor Chang-Ock Lee
- A PostDoc in Computational Mathematics and Imaging Lab.

- Institute of mathematics and its applications (IMA), Minneapolis, Minnesota, USA
- Solved a challenge problem posted in IMA Impacts: An eye for aphids
- Funding: Korean Research Foundation, KRF-2006-311-C00015.

Research assistant January 2005 - March 2005

- Nourishment of KAIST brand supported by the small and medium business administration & KAIST
- Cooperated with Interactive technology for the value improvement (INTVIM)
- Result: Development of 3D virtual reality engine based on real photo

4 Academic Experience

Teaching

- English: Level set method in industrial problems, STUBA (February 2024 - May 2024)
- English: Professional presentation in applied mathematics, STUBA (September 2023 - December 2023)
- English: Seminal papers in image processing before AI era, STUBA (February 2023 - May 2023)
- Finite volume method: Coding in AVL FIRE[™] for the evolution of surfaces on polyhedral meshes, STUBA (September 2022 December 2022)
- English: Professional presentation in applied mathematics, STUBA (September 2022 - December 2022)
- Numerical analysis of differentiation equations: Level Set Methods in Evolving Manifolds, STUBA (February 2022 May 2022)
- Real Analysis I and II, Vector Calculus, Differential Geometry, SSAMPLUS (June 2008 - October 2008)

• Numerical Analysis I, KAIST (March 2008 - May 2008)

- Computational mathematics laboratory, KAIST
- Regular system management of Linux and Window XP
- Establishment of integrated Window XP system on Linux using Samba primary domain controller

Teaching assistant

- Calculus, Linear algebra, Set theory, Ordinary differential equation, Differential geometry KAIST (March 2000 February 2004)
- Calculus, NTU (November 2008 - October 2010)

- Information display laboratory, Electronic engineering, Inha university
- Study of tensor fields for understanding physical properties of liquid crystal display

- Photonic integrated circuit & quantum device laboratory, Information & communication engineering, Inha university
- Construction of small model of HESS (Hoop energy storage system)

5 Invited Talks

- Advances in High-order Methods Fluid Dynamics, Biomedical Science, and Exascale Computing, PostTech, Pohang, South Korea, June 10-13, 2024, Title: Level set methods on polyhedral meshes.
- A series of seminars, KAIST, Daejeon, South Korea, July 19-21, 2023, Title: Image Processing before the Era of Neural Network.
- Discrete Duality Finite Volume Method and Applications, Jean-Morlet Chair Workshop, CIRM, Marseille, France, October 17-21, 2022, *Finite Volume Method for Level Set Equations on Polyhedral* Meshes.
- Workshop on Scientific Computing 2022, Děčín, Czech Republic, May 26-29, 2022, Title: What is a proper boundary condition to solve eikonal equation on a non-convex domain?
- ALGORITMY 2020, Conference on Scientific Computing, Vysoke Tatry, Podbanske, September 10-15, 2020, Title: *Finite volume level set methods in combustion engines*
- Summer School for modeling in medical mathematics, July 2-4, 2019, Title: Modeling for Medical Mathematics: Evolution of Manifolds, Finite Volume Method, and Deep Learning

6 Minisymposium Organizer

- SIAM Conference on Imaging Science, May 28-31, 2024, Atlanta, USA, Title: Surface reconstruction: PDEs, Variational, and Deep Learning Methods Part I and II
- ALGORITMY 2024, March 15-20, 2024, High Tatra Mountains, Slovakia, Title: Numerical methods for level-set and eikonal equations theory and applications
- International Congress on Industrial and Applied Mathematics, August 20-25, 2023, Tokyo, Japan, Title: Numerical Algorithms for the Eikonal Equation and Its Applications
- International Congress on Industrial and Applied Mathematics, July 15-19, 2019, Valencia, Spain, Title: Advanced numerical methods for evolving manifolds
- Europe-Korea Conference on Science and Technology, August 20-24, 2018, Glasgow, UK. Title: Information technology and machine learning
- 6th European Conference on Computational Mechanics, 7th European Conference on Computational Fluid Dynamics, June 11-15, 2018, Glasgow, UK. Title: *Moving interface problems in computational fluid dynamics*
- Europe-Korea Conference on Science and Technology, July 26-29, 2017, Stockholm, Sweden. Title: Industrial mathematics for scientific computing: Imaging and machine learning and computational fluid dynamics

- Europe-Korea Conference on Science and Technology, July 27-30, 2016, Berlin, Germany. Title: Contemporary topics in image processing and computer vision
- SIAM Imaging Science, May 23-26, 2016, New Mexico, USA. Title: *PDE-based image processing:* Reconstruction, filtering, segmentation, compression, and inpainting
- International Conference on Numerical Combustion, April 19-22, 2015, Avignon, France. Title: Surface evolution methods in gasoline direct injection combustion engines
- SIAM Imaging Science, May 20-22, 2012, Philadelphia, USA. Title: Functional analysis and accurate numerical methods in image processing
- International Congress on Industrial and Applied Mathematics, July 18-22, 2011, Vancouver, Canada. Title: Fast optimization algorithms in image processing and its applications
- SIAM Imaging Science, April 12-14, 2010, Chicago, USA. Title: Surface reconstruction from sparse gradient fields, unorganized point clouds, and photometric stereo

7 Patent

- Real-time fine dust monitoring system and its methods, KR20210050831A, 2021, Seungjun Jeon, Jun Beum Kim, Jooyoung Hahn, and Seong Weon Jeong.
- A method for reconstructing a 3d surface from a 2d sketch, CN103460252B, 2017, Jie Qiu, Jooyoung Hahn, Eiji Sugisaki, Lei Jia, Xue-Cheng Tai, and Hock Soon Seah.
- Methods and systems for generating enhanced images using Euler's Elastica model, US8447135B2, 2013, Xue-Cheng Tai, Jooyoung Hahn, Jason Ginmo Chung.
- A method for reconstructing a 3d surface from a 2d sketch, WO2012118439A1, 2012, Jie Qiu, Jooyoung Hahn, Eiji Sugisaki, Lei Jia, Xue-Cheng Tai, and Hock Soon Seah.
- Method for image segmentation using statistically reinstating force and multi-resolution, KR100925180B1, 2009, Chang-Ock Lee, Sung Ha Park, and Jooyoung Hahn.

8 Funding

AVL AST University Partnership Program (principal investigator)

• AVL FIRE[™] and PREONLAB, May 2022 - Apr 2025. Accepted.

Global Visiting Fellowship at Seoul National University, South Korea

- Topic: Neural network solver for PDEs, June 2023 Aug 2023. Accepted.
- Topic: Application of the eikonal equation and Surface-to-surface radiation, June 2024 Aug 2024. Accepted.
- SASPRO2/Horizon 2020 Marie Skłodowska-Curie COFUND Action Programme (principal investigator)
- Title: Numerical methods for computational evolving manifolds, Feb 2022 Jan 2025. Accepted.

K-TAG: Technical Consulting for EUREKA/EUROSTAR

- Title: Analysis and prediction of evolving particulated matter in the air, 2018, Metariver Technology Co., Ltd.. Accepted.
- Title: Health care system for emotion and stress measurement based on image processing, 2019, Inforshare. Accepted.
- Title: Exploration of Overseas Partners and International Collaborative R&D Project Planning for Real-time Simulation Cyber-Physical Systems (CPS) System Development, 2020, UVC Co.,Ltd.. Accepted.

EIC Pathfinder (co-investigator)

• Title: Unified Diagnosis Platform by Nano-Metric Molecular Sensing, Submitted in 2022 and 2023. Not accepted.

Industrial Project (project leader in AVL)

• Title: Finite volume level-set methods for G-equation in AVL $FIRE^{TM}$, Feb 2017 - Jul 2017. Accepted.

FETOPEN (co-investigator)

• Title: Computational Evolving Manifolds for Future Emerging Technology, Submitted in 2015 and 2016. Not accepted.

Humbolt Research Fellowship in 2012

• Title: Higher-order Regularity in PDE-based Image Analysis and Computer Vision, Host: Prof. Daniel Cremers in Department of Computer Science, Technical University of Munich, Germany. Not accepted.

Korean Research Foundation, KRF-2006-311-C00015

• Visiting researcher at Institute of mathematics and its applications (IMA), Minneapolis, Minnesota, USA, Aug 2005 - Jul 2006. Accepted

9 Awards

K-TAG awards 2019 for consulting business

- Analysis and prediction of evolving particulated matter in the air
- Health care system for emotion and stress measurement based on image processing.
- News: click the link

English Teaching Award: Numerical Analysis I, KAIST, Spring semester in 2008

KSIAM Young researcher award

- Korean society for industrial and applied mathematics (KSIAM) 2007 spring conference, May 25-26, 2007, KAIST, South Korea
- Title: Fine segmentation using geometric attraction-driven flow and edge-regions

University students contest of mathematics held by the Korean Mathematical Society

- Honorable mention prize in November 1998
- Bronze prize in November 1997

Inha University

- Summa cum Laude, with honors in engineering
- University scholarship, 1995-1999

10 Languages

Communication

- English (Fluent)
- Korean (Native)
- German (Basic)

Computation

- Python (2022 present): Development of data analysis in 2D chromatography, tumor microenvironments, and high performance computing in TDA.
- FORTRAN (2012 present): Development of commercial CFD software and computational geometry algorithms.
- MPI and parallel computing (2012 present): Development of commercial CFD software and computational geometry algorithms.
- Linux (2002 present), System manager of Linux (2002 2003): Integration of linux and window systems, security, web server, etc.
- C, C++ (1995 2014), Visual Studio, MFC, API (2002 2008): Development of in-house codes for computer vision and image processing. (three patents)
- GPU (2008 2010): Development of real-time 3D reconstruction from hand drawing sketch. (a patent)
- Others: Tools for TDA (Gudhi and Ball Mapper), Latex, Matlab, HTML

11 Soft Skills

Singing in a choir: 2nd Bass

- UniChor in Graz by the conductor Matthias Unterkofler
- Cappella Nova Graz by the conductor Otto Kargl

Cooking

• Home Cooking (Instagram)