Jooyoung Hahn's Curriculum Vitae

CONTACT
INFORMATION
Department of Mathematics and Descriptive Geometry,
Faculty of Civil Engineering,
Slovak University of Technology
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RESEARCH
INTERESTS

- Numerical algorithms for partial differential equations (PDEs), Computational fluid dynamics (combustion and multiphase simulation) on polyhedral meshes in 3D, Level set methods, Numerical PDEs in neural networks.
- Nonconvex and nonsmooth optimization and nonconvex constraint optimization: p-elastica model and Mumford-Shah model.
- Image segmentation, Image denoising and enhancement, Image inpainting, 3D surface reconstruction
- Topological data analysis (TDA)

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

M.S., Mathematics　　　　　　　　　　　　　　March 2000 - February 2002
- KAIST, Deajeon, South Korea
- Advisor: Jin Hwan Lim
- Area of Study: Riemannian geometry

B.S., Electronic material & devices engineering　　　March 1995 - February 2000
- Inha University, Incheon, South Korea
- Second major: Mathematics

PROFESSIONAL
CAREER

SASPRO2 Fellow　　　　　　　　　　　　　　February 2022 - Present
- Funding: SASPRO2 (Slovak Academic and Scientific Programme and Marie Skłodowska-Curie Cofund)
- Hosting University: Department of Mathematics and Descriptive Geometry, Faculty of Civil Engineering, Slovak University of Technology, Radlinskeho 11, 810 05 Bratislava, Slovakia
- Project Leader: PhD Jooyoung Hahn
- Science in Charge: Professor Karol Mikula
- Topic: Numerical methods for computational evolving manifolds

K-TAG Europe　　　　　　　　　　　　　　　July 2016 - Present
- 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 expert   July 2019 - Present

Senior Development Engineer Software Fluid Dynamics May 2012 - December 2021
- 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 (Eikonal equation on polyhedral meshes).
  - Level set method with adaptive mesh refinement for multiphase flow.
  - Accurate gradient computations

Rapid Innovation Team, Advanced Simulation Technologies, AVL Mar 2019 - June 2019
- Advanced Simulation Technologies, AVL, Graz, Austria
- Complete Vehicle Energy Management Control Optimization (Level-Set Dynamic Programming)

Senior Postdoc.   November 2010 - April 2012
- Institute for mathematics and scientific computing, University of Graz, Graz, Austria
- Advisor: Professor Michael Hintermueller
- A senior PostDoc in START Project:"Interfaces and Free Boundaries"

Research staff   November 2008 - October 2010
- Division of Mathematical Sciences, Nanyang Technological University, Singapore
- Advisor: Professor Xue-Cheng Tai
- A research staff in Mathematical Imaging and Vision Group

Postdoc.   March 2008 - October 2008
- Department of Mathematical Sciences KAIST, Deajeon, South Korea
- Advisor: Professor Chang-Ock Lee
- A PostDoc in Computational Mathematics and Imaging Lab.

Visiting researcher   August 2005 - July 2006
- Institute of mathematics and its applications (IMA), Minneapolis, Minnesota, USA
- Solved a challenge problem posted in IMA Impacts: An eye for aphids
- Supported by the 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

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- Topological data analysis (TDA)

INVITED TALKS

- A series of seminars, KAIST, Daejeon, South Korea, July 19-21, 2023, Title: *Image Processing before the Era of Neural Network.*
- 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*

MINISYMPOSIUM ORGANIZER

- SIAM Conference on Imaging Science, May 28-31, 2024, Atlanta, USA, Title: *Surface reconstruction: PDEs, Variational, and Deep Learning Methods - Part I of 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, Philadepphia, 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*

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
- Numerical Analysis I,
  KAIST   February 2008 - May 2008

Computer system manager   March 2002 - August 2003
- 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

Undergraduate researcher   March 1997 - February 1998
- Information display laboratory, Electronic engineering, Inha university
- Study of tensor fields for understanding physical properties of liquid crystal display

Undergraduate researcher   March 1996 - February 1997
- Photonic integrated circuit & quantum device laboratory, Information & communication engineering, Inha university
- Construction of small model of HESS (Hoop energy storage system)

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.

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

LANGUAGES   *Communication*

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

Computation
- Python (2022 - present): Development of data analysis in 2D chromatography and tumor microenvironment 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

SOFT SKILLS

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

Cooking
- Home Cooking in Instagram