Yongjin Choi, Ph.D.

Postdoctoral Fellow, InnoCORE PRISM-AI Center, Korea Advanced Institute of Science & Technology (KAIST)
Affiliated Researcher, School of Civil and Environmental Engineering, Georgia Institute of Technology
yj.choi@kaist.ac.kr | Website | +82 10-5153-9271

EDUCATION

Ph.D. in Civil Engineering **2024**
***The University of Texas at Austin**, Department of Civil, Architectural and Environmental Engineering, USA*
- Specialty area: geotechnical engineering
- Dissertation: Forward and Inverse Modeling of Granular Flows Using Differentiable Graph Neural Network Simulator
- Advisor: Prof. Krishna Kumar
- GPA: 3.91/4.0

M.S. in Civil Engineering **2019**
***Pusan National University**, Department of Civil and Environmental Engineering, South Korea*
- Specialty area: geotechnical engineering
- Thesis: Stiffness Evaluation of Open-Graded Aggregate Base Corresponding to Compaction Level Based on Plate Load Tests
- Advisor: Prof. Jaehun Ahn
- GPA: 4.30/4.50

B.S. in Civil Engineering **2017**
***Pusan National University**, Department of Civil and Environmental Engineering, South Korea*
- GPA: 3.80/4.50

RESEARCH EXPERIENCE & EMPLOYMENT

Postdoctoral Fellow (Supervisor: Seunghwa Ryu) **09/2025 – Current**
*InnoCORE PRISM-AI Center, **Korea Advanced Institute of Science & Technology (KAIST)**, South Korea*
- Developing AI-based frameworks to accelerate inverse design and manufacturing using physics-informed machine learning and LLM agents.

Affiliated Research Fellow (Supervisor: Jorge Macedo) **09/2024 – Current**
*Geosystems Engineering Group**, Georgia Institute of Technology**, USA*
- Continuing collaborative research initiated during postdoctoral fellowship.

Postdoctoral Fellow (Supervisor: Jorge Macedo) **05/2024 – 09/2025**
*Geosystems Engineering Group**, Georgia Institute of Technology**, USA*
- Developed graph neural network simulator-based forward and inverse modeling, and design optimization for landslides and slope system runout, with user-friendly GUI support.
- Worked on establishing a large-scale cone penetration test simulation database with GPU-accelerated material point method using distributed computing.
- Developed neural operator for geotechnical partial differential equations and accelerating uncertainty quantification.
- Implemented differentiable soil constitutive models for efficient calibration, inverse analysis, and data-driven model enhancement.

This work resulted in **four papers under review** for journal publications, **two conference presentations**, and ongoing mentoring of two PhD students, and is being continued in collaboration with Georgia Tech through an affiliated postdoctoral position.

Graduate Research Assistant (Supervisor: Krishna Kumar) **06/2021 – 05/2024**
Extreme-Scale Computational Geomechanics Lab, ***The University of Texas at Austin**, USA*
- Developed an AI-based approach for extracting material properties from visual data of sand collapse using neural rendering techniques.
- Worked on forward and inverse modeling of flows in porous media using graph neural network simulator.
- Developed a generalizable forward and inverse modeling approach for granular flows, based on differentiable graph neural

network simulator with automatic differentiation and gradient-based optimization.

- Contributed to developing the PyTorch version of the graph neural network simulator for granular and fluid flows exploiting distributed data parallelism for multi-GPU training under high-performance computing (HPC) environment [Code].
- Developed pore pressure response prediction model for liquefiable sand under cyclic loading using machine learning approach (LSTM).

This research yielded two journal papers and five conference presentations. I also mentored four graduate students, including a classroom project. This work was funded by multiple NSF grants, including a $7M AI-driven cyberinfrastructure innovation project in civil and environmental engineering.

Postgraduate Research Assistant (Supervisor: Jaehun Ahn) **2019 – 2020**
Geosystems Lab, ***Pusan National University****, South Korea*

- Evaluated the behavior of laterally-loaded pile groups using 3D numerical analysis.

This work resulted in two journal papers, and mentoring of one graduate student published the other paper, and was funded through the Korean Ministry of Land, Infrastructure and Transport.

Graduate Research Assistant (Supervisor: Jaehun Ahn) **2017 – 2019**
Geosystems Lab, ***Pusan National University****, South Korea*

- Investigated the mechanical and hydraulic characteristics of open-graded aggregate base and permeable pavement materials based on laboratory and field tests.

This work resulted in six journal papers, three conference presentations, and multiple technical reports, and was funded through the Korean Research Foundation, and the Ministry of Land, Infrastructure and Transport.

PEER-REVIEWED PAPERS (* Corresponding author)

- (Submitted) **Choi, Y.**, Lee, S.* (2026) "Accelerating stochastic simulation of post-failure landslide runout using a random graph neural network-based simulator" *Computers & Geotechnics*
- (Under review) **Choi, Y.**, Macedo, J.* (2025) "Differentiable graph neural network simulator for the back-analysis of post-liquefaction residual strength from flow failure runout." *Canadian Geotechnical Journal*
- (Under review) **Choi, Y.**, Liu, C., Macedo, J.* (2025) "Enhanced DeepONet for 1-D consolidation operator learning: an architectural investigation." *Computers and Geotechnics* [Pre-print]
- (Under review) Ryou, J. E., **Choi, Y.**, Dai., S., Jung, J.* (2025) "The Interplay Between Pore and Particle Characteristics in Sands Based on Computed Tomographic Image Analyses." *Computers & Geotechnics*
- (Under review) **Choi, Y.**, Macedo, J.*, Liu, C. (2025) "Differentiable graph neural network simulator for forward and inverse modeling of multi-layered slope system with multiple material properties." *Soils and Foundations* [Pre-print]
- Bae, B., **Choi, Y.***, Jung, H., Ahn, J.* (2025) "Tunnel lining segmentation from ground-penetrating radar images using advanced single-and two-stage object detection and segmentation models." *Computer-Aided Civil and Infrastructure Engineering* [Link]
- Kim, T., Shahriar, A. R., Lee, W.-D.*, **Choi, Y.**, Kwon, S., & Gabr, M. A. (2025) "Field data-based prediction of local scour depth around bridge piers using interpretable machine learning." *Transportation Geotechnics*, 52, 101567. [Link]
- **Choi, Y.**, Bae, B., Han, T. H., Ahn, J.* (2024) "Application of Mask R-CNN and YOLOv8 Algorithms for Concrete Crack Detection." *IEEE Access*. [Link]
- **Choi, Y.***, Kumar, K. (2024) "Inverse Analysis of Granular Flows Using Graph Neural Network-Based Simulator." *Computers and Geotechnics*, 171, 106374. [Link] [Code]
- **Choi. Y.**, Nguyen, H. T., Han, T. H., Choi. Y., Ahn. J.* (2024) "Sequence Deep Learning for Seismic Ground Response Modeling: 1D-CNN, LSTM, and Transformer Approach." *Applied Science*, 14 (15), 6658 [Link] [Code]
- Lee, Y., Lee, D., Lee, H., Choe, H. S., Kim, J. H., **Choi, Y.***, Ahn, J.* (2024). "Removal Efficiency of Bottom Ash and Sand Mixtures as Filter Layers for Fine Particulate Matter. " *Materials*, 17(11), 2749. [Link]
- **Choi, Y.***, Kumar, K. (2024). "Graph Neural Network-based Surrogate Model for Granular Flows." *Computers and Geotechnics*, 116, 106015. [Link] [Code]
- Kumar, K., **Choi, Y.** (2023). "Accelerating Particle and Fluid Simulations with Differentiable Graph Networks for Solving Forward and Inverse Problems." *The International Conference for High Performance Computing, Networking, Storage and Analysis* **(Top-tier conference in computer science)**, Denver, USA. [Link]
- Lee, Y., **Choi, Y.**, Ahn, D., Ahn, J*. (2021). "Prediction Models Based on Regression and Artificial Neural Network for

Moduli of Layers Constituted by Open-Graded Aggregates." *Materials*, 14(5), 1199. [Link]

- **Choi, Y.**, Ahn, D., Lee, Y., Ahn, J*. (2020). "Compaction Quality Monitoring of Open-Graded Aggregates by Light Weight Deflectometer (LWD) and Soil Stiffness Gauge (SSG)." *Sustainability*, 12(6), 2521. [Link]
- **Choi, Y.**, Ahn, D., Nguyen, T. H., Ahn, J*. (2018). "Assessment of Field Compaction of Aggregate Base Materials for Permeable Pavements Based on Plate Load Tests." *Sustainability*, 10(10), 3817. [Link]

PEER-REVIEWED JOURNAL PAPERS (Korean Journals) (* Corresponding author)

- Jong, J., **Choi, Y.**, Ahn, J. (2021). "Evaluation of py Curves for Group Piles in Cohesive Soil Based on 3D Numerical Analysis." *Journal of the Korean Society of Hazard Mitigation*, 21(6), 193-200. [Link]
- **Choi, Y.**, Ahn, J*. (2020). "Evaluation of *p-y* Curves and *p*-multiplier of Pile Groups Corresponding to Sand Properties Change Based on 3D Numerical Analysis." *Journal of the Korean Society of Hazard Mitigation*, 20(4), 207-2017. [Link] [Code]
- **Choi, Y.**, Nguyen, T. H., Ahn, J*. (2019). "Resilient Modulus and Permanent Deformation of 40 mm Open-Graded Aggregates based on Repeated-Load Triaxial Tests." *Journal of the Korean Society of Hazard Mitigation*, 19(7), 367-374. [Link]
- **Choi, Y.**, Oh, J., Han, S. I., Ahn, J., Shin, H. S*. (2017). "Elastic Modulus and Layer Coefficient of Permeable Block Pavements Based on Plate Load Tests." *Journal of the Korean Geotechnical Society*, 33(12), 75-80. [Link]

CONFERENCE PRESENTATIONS

- **Choi, Y. (Oral presenter)**, Cornejo, R., Macedo, J., Kumar, K. (2024). "AI/MPM-based assessment of Dam break Failure modes and Runout." TAILENG Annual Meeting, Denver, Colorado.
- **Choi, Y. (Poster presenter)**, Kumar, K. (2024). "Three-dimensional granular flow simulation using graph neural network-based learned simulator." *Geo-Congress 2024*, Vancouver, Canada. [Link]
- Kumar, K., Mehta, C., **Choi, Y. (Oral presenter)** (2023). "Graph Network Simulator and Differentiable Material Point Method." *Advances in Computational Mechanics 2023*, Austin, USA.
- **Choi, Y. (Oral presenter)**, Kumar, K. (2023). "Slope Inverse Analysis Using Accurate and Generalizable Data-Driven Surrogate Granular Flow Simulator." *17th National Congress on Computational Mechanics*, Albuquerque, USA.
- **Choi, Y. (Oral presenter)**, Kumar, K. (2022). "A Machine Learning Approach to Predicting Pore Pressure Response in Liquefiable Sands Under Cyclic Loading." *Geo-Congress 2023*, Los Angeles, USA. [Link] [Code]
- **Choi, Y. (Poster presenter)**, Lee, S, Jung, J., Oh, J., Ahn, J. (2018). "Coefficient of Subgrade Reaction for the Permeable Block and Base System at Korea GI and LID Center." *Proceedings of the 5th GeoChina International Conference*, Hangzhou, China. [Link]
- **Choi, Y. (Oral presenter)**, Ahn, D., Nguyen, H. T., Ahn, J. (2018). "Measurement of Elastic Modulus of 40 mm Crushed Stone Aggregate with Field Compaction Effort." *Korean Society of Railway Spring Conference 2018*, Jeju, South Korea.
- **Choi, Y. (Oral presenter)**, Jalmasco, M. M., Ahn, J. (2017). "Permeability Degradation of Permeable Pavement Material due to Clogging." *JpGU-AGU Joint Meeting 2017*, Chiba, Japan.

TEACHING EXPERIENCES

Guest Lecturer **Fall 2025**

***Deep Learning and Its Application to Geotechnical Systems**, Pusan National University, South Korea*

- Delivered a two-hour lecture on physics-informed neural networks and graph neural networks for geotechnical modeling for graduate students.

Assistant Instructor **Spring 2025**

***Numerical Modeling and Data Science for Geotechnics (CEE-8813-H)**, Georgia Institute of Technology, USA*

- Designed and delivered lectures and course materials on material point methods [link], finite element methods [link], and regression and classification machine learning models for geotechnical engineers, which are publicly available through open-source websites.

Pedagogical Training **2024**

***Center for Teaching and Learning**, The University of Texas at Austin, USA*

- Earned an advanced teaching certificate through seven workshops for developing teaching skills in pedagogical theory, lesson planning, student participation, and assessment.

Classroom Project Mentor **Spring 2023**

***Scientific Machine Learning (CE 397)**, The University of Texas at Austin, USA*

- Mentored a graduate student team in developing a graph neural network-based simulator for slope failure, resulting in an "A" grade for the final project report.

Teaching Assistant **Spring 2023**

***Introduction to Computer Methods (CE 311K)**, The University of Texas at Austin, USA*

- Hosted weekly laboratory sessions for hands-on Python coding activities for engineering problems, held regular office hours, and managed grading tasks.

Teaching Assistant **Spring 2021**

***Probability and Statistics for Civil Engineers (CE 311S)**, The University of Texas at Austin, USA*

- Designed and hosted weekly laboratory sessions with hands-on problem-solving activities, held regular office hours, and managed grading tasks.

INVITED TALKS

- Invisted speaker, "GNN-based surrogate modeling", Department of Mechanical Engineering, Ulsan National Institute of Science & Technology (UNIST), South Korea **11/2025**
- Invited speaker, "Physics-aware AI for geohazard modeling", Department of Civil and Environmental Engineering, Korea Advanced Institute of Science & Technology (KAIST), South Korea. **10/2025**

FUNDING EXPERIENCE

- Drafted a grant proposal that secured substantial computing resources (500,000 SUs, valued at approximately $30,000) from the Texas Advanced Computing Center (TACC) under the supervision of Dr. Kumar.

HONORS AND AWARDS

- Young scholar award, Korean Geotechnical Society **2023**
- Award for 2nd best poster presentation in graduate student symposium of civil, architectural, and environmental engineering, The University of Texas at Austin **2022**
- Scholarship for outstanding graduate student research paper, Brain Korea 21 Plus **2019**
- Scholarship from "Earthquake Disaster Prevention Human Resource Development Course", Korean Ministry of the Interior and Safety **2017 – 2018**
- Award for excellence in nationwide university student construction management competition (3rd out of 38 teams), Mooyoung Construction Management Corporation **2016**
- Scholarship for academic excellence, Korea Student Aid Foundation **2015 – 2016**

SOFTWARE DEVELOPMENT

Learn-MPM-2D **2024**

- Developed an open-source learning package for the 2-D material point method [link], guiding learners from core theory to hands-on practice in a beginner-friendly interactive Python notebook environment.

Cbgeopy: material point method model generator [Code] **2024**

- Developed a material point method model generator that supports various geometries from simple columns to multi-layered 3D topography, which can be integrated with CB-Geo MPM.

GNS: A generalizable Graph Neural Network-based simulator for particulate and fluid modeling [Code] **2023**

- Contributed as a core developer to implement mesh graph network for fluid modeling, multi-material features, and code maintenance works.

PROFESSIONAL LICENSES & CERTIFICATIONS

- Engineering in Train (EIT), Civil Engineering, NCEES, USA **2023**
- Machine Learning, Stanford University and Coursera [Link] **2022**
- License of Engineer (FE) Civil Engineering, Human Resources Development Service of Korea **2016**

OUTREACH & SERVICE ACTIVITIES

Advisory Board in Revolutionizing Engineering Departments (RED) program, Georgia Institute of Technology **2025**

- Engaged in ongoing educational innovation to incorporate computational thinking and artificial intelligence into the Civil and Environmental Engineering program.

Machine Learning Model Developer in DesignSafe Academy/NHERI Hackathon **2022**

- Participated in team hackathon project for machine learning and high-performance computing held in Texas Advanced Computing Center, and developed p-wave arrival time detector from earthquake source using LSTM and CNN [Code]

President of Korean Civil Engineering Student Association at the University of Texas at Austin **2022**

- Led and represented the organization, holding semester-wise social gatherings to foster a supportive environment for Korean civil engineering students.

Journal Reviewer

- Chemical Engineering Journal, Journal of Traffic and Transportation Engineering, Journal of Rock Mechanics and Geotechnical Engineering **2021-2025**

TECHNICAL SKILLS

- Machine learning: Jax, PyTorch, TensorFlow, Distributed GPU training
- Scientific computing: Python, Linux, Matlab, C++, Distributed computing on high-performance computing environments
- Development: Git and Github, Docker, Apptainer, Hugging Face
- Numerical analysis: CB-Geo MPM [Link], GeoTaichi MPM [Link], Plaxis 3D, SAP2000

REFERENCES

Dr. Seunghwa Ryu, Ph.D. (Postdoctoral Research Supervisor)

Professor, *Department of Mechanical Engineering, KAIST, South Korea*
Email: ryush@kaist.ac.kr | Phone: +82 42-350-3019

Dr. Jorge Macedo, Ph.D. (Postdoctoral Research Supervisor)

Associate professor, *School of Civil and Environmental Engineering, Georgia Institute of Technology, USA*
Email: jorge.macedo@gatech.edu | Phone: +1 404-894-3052

Dr. Krishna Kumar, Ph.D. (Ph.D. Supervisor)
Assistant professor, *Department of Civil, Architectural and Environmental Engineering, University of Texas at Austin, USA*
Email: krishnak@utexas.edu | Phone: +1 512-232-4406

Dr. Ellen Rathje, Ph.D. (Ph.D. Committee Member)
Professor, *Department of Civil, Architectural and Environmental Engineering, University of Texas at Austin, USA*
Email: e.rathje@mail.utexas.edu | Phone: +1 512-232-3683

Dr. Jaehun Ahn, Ph.D. (M.S. Supervisor)
Professor, *Department of Civil and Environmental Engineering, Pusan National University, South Korea*
Email: jahn@pusan.ac.kr | Phone: +82 51-510-7627