

Minseok Choi

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RESEARCH INTERESTS

- Scientific Machine Learning and AI for Science
- Uncertainty Quantification and Stochastic Simulation
- High-performance Scientific Computing
- Mathematical and Data-driven Modeling

EDUCATION

Seoul National University B.S. in Mechanical and Aerospace Engineering Dual Major in Mathematics	2002
Seoul National University M.S. in Mechanical and Aerospace Engineering Advisor: Frank Chongwoo Park	2007
Brown University Ph.D. in Applied Mathematics Advisor: George Karniadakis Thesis: Time-dependent Karhunen-Loève type decomposition methods for SPDEs	2014

EMPLOYMENT

POSTECH Assistant Professor in Mathematics	2017-present
Princeton University Postdoctoral Research Associate	2014-2017
Brown University Postdoctoral Research Associate	2014

PREPRINTS

- K. Yeo, H. Shin and M. Choi, Learning Random Dynamical System from Noisy Observations, *under revision*
- E. Kim, S. Cho, H. Kwon, K. Yeo and M. Choi, Stabilize physics-informed neural networks for stiff differential equations: Re-Spacing layer, *under review*
- J. Lee, S. Shin, T. Kim, B. Park, C. Lee, I. Ye, H. Choi, A. Lee, M. Choi and S. Lee, Re-initialization Strategy for Physics-informed Neural Networks in Fluid Flow Analysis, *under review*
- T. Kim, S. Shin, J. Lee, C. Lee, I. Ye, H. Choi, M. Choi and S. Lee, A Physics-informed Convolutional Framework for Digital Twins: Fast and Accurate Approximation of Numerical Simulation, *under review*

- E. Kim, H. Kwon, S. Cho, D. Kwon, H. Choe, and M. Choi, Fluid Simulation of DC Discharge using Physics-informed Neural Networks, *in preparation*
- Y. Jeon, H. Kim, H. Shin and M. Choi, A Data-Driven Thermal Model of PCBs Using ViT Deep Operator Networks, *in preparation*
- Q. Cao, H. Shin, Z. Zou, G. Karniadakis, and M. Choi. Physics-informed Laplace Neural Operator, *in preparation*
- J. Jung, H. Shin and M. Choi, Operator Learning Methods for forward and inverse problem of fluid flow, *in preparation*
- H. Shin, E. Kim and M. Choi, Gaussian processes for nonlinear differential equations, *in preparation*

PUBLICATIONS

- H. Kwon, E. Kim, S. Cho, D. Kwon, H. Choe and M. Choi, Plasma-simulation physics informed neural networks (PS-PINNs) for global discharge models, *East Asian Journal on Applied Mathematics*, 14(3), 636-656, 2024
- J. Jung, H. Kim, H. Shin and M. Choi, CEENs: Causality-enforced evolutonal networks for solving time-dependent partial differential equations, *Computer Methods in Applied Mechanics and Engineering*, 427, 117036, 2024
- J. Jung, H. Shin and M. Choi, Bayesian deep learning framework for uncertainty quantification in stochastic partial differential equations, *SIAM Journal on Scientific Computing*, 46(1), C57-C76, 2024
- J. Jung and M. Choi, Data-driven method to quantify correlated uncertainties, *IEEE Access*, 11, 50605-50618, 2023
- H. Shin and M. Choi, Physics-informed variational inference for uncertainty quantification of stochastic differential equations, *J. Comp. Phys.*, 487, 112183, 2023
- S. Cho and M. Choi. MGDGAN: Multiple Generator and Discriminator Generative Adversarial Networks for Solving Stochastic Partial Differential Equations, *IEEE Access*, 10, 130908-130920, 2022
- P. G. Kevrekidis, M. O. Williams, D. Mantzavinos, E. G. Charalampidis, M. Choi and I. G. Kevrekidis. Revisiting diffusion: Self-similar solutions and the $t^{-1/2}$ decay in initial and initial-boundary value problems, *Quart. Appl. Math.*, 75, 581-598, 2017
- H. Babaee, M. Choi, T. Sapsis, and G.E. Karniadakis. A robust bi-orthogonal/dynamically-orthogonal method using the covariance pseudo-inverse for the stochastic Navier-Stokes equations, *J. Comp. Phys.*, 344, 303-319, 2017
- M. Choi, T. Bertalan, C.R. Laing, and I.G. Kevrekidis. Dimension reduction in heterogeneous neural networks: generalized Polynomial Chaos (gPC) and Analysis-Of-Variance (ANOVA), *Eur. Phys. J. Special Topics*, 225(6), 1165-1180, 2016
- M. Choi, T. Sapsis, and G.E. Karniadakis. On the equivalence of dynamically orthogonal and bi-orthogonal methods: Theory and Numerical simulations, *J. Comp. Phys.*, 270, 1-20, 2014
- M. Choi, T. Sapsis, and G.E. Karniadakis. A convergence study for SPDEs using combined polynomial chaos and dynamically-orthogonal schemes, *J. Comp. Phys.*, 245, 281-301, 2013
- D. Venturi, M. Choi, and G.E. Karniadakis. Supercritical quasi-conduction states in stochastic Rayleigh Benard convection, *Int. J. of Heat & Mass Transfer*, 55(13-14), 3732-3743, 2012
- X. Yang, M. Choi, G. Lin, and G.E. Karniadakis. Adaptive ANOVA decomposition of stochastic incompressible and compressible flows, *J. Comp. Phys.*, 231, 1587-1614, 2012

- Z. Zhang, M. Choi, and G.E. Karniadakis. Error estimates for the ANOVA method with polynomial chaos interpolation: Tensor product functions, *SIAM J. Sci. Comp.*, 34(2) A1165-A1186, 2012
- Z. Zhang, M. Choi, and G.E. Karniadakis. Anchor Points Matter in ANOVA Decomposition, *Spectral and High Order Methods for Partial Differential Equations, Lecture Notes in Computational Science and Engineering*, 76, 347-355, 2011
- S. Lee, M. Choi, H. Kim, and F.C. Park. Geometric direct search algorithms for image registration, *IEEE Transactions on Image Processing*, 16, 2215-2224, 2007
- J. Kwon, M. Choi, F.C. Park, and C. Chun. Particle filtering on the Euclidean group: framework and applications, *Robotica*, 25, 725-737, 2007

FUNDING

- PI, "PINN을 이용한 소성로 해석가속화 및 공정조건 최적화", POSCO HOLDINGS, 2024.01-2024.09
- PI, "PIML 인공지능 기반 열 유동 예측 툴 개발 (PART1)", Hyundai Mobis, 2023.04-2024.09
- PI, "PIML (Physics-informed machine learning)을 이용한 시뮬레이션 방법 개발", Korea Institute of Fusion Energy, 2023.01-2026.10
- PI, "머신러닝 기반의 고차원 편미분방정식 수치적 방법 및 불확실성 정량화", National Research Foundation of Korea, 우수신진연구, 2021.03-2026.02
- co-PI, "BK21 포스텍 수리과학 교육연구단", National Research Foundation of Korea, 2020.06-2024.02
- co-PI, "크로스 도메인 호환성을 위한 블록체인 플랫폼 및 비즈모델 개발", National Research Foundation of Korea, 2018.06-2019.12
- PI, "고차원 시스템의 불확실성 정량화를 위한 수치 해석 연구", National Research Foundation of Korea, 생애첫연구, 2017.03-2019.02

SERVICE

Scientific Activities:

- Vice President, East Asian Society for Industrial and Applied Mathematics
January 2025 - December 2026
- Managing Editor, Journal of the Korean Society for Industrial and Applied Mathematics
January 2021 - December 2022

Editorial Board:

- Associate Editor, East Asian Journal on Applied Mathematics
January 2025 -
- Guest Editor, Special Issue of "Data-Driven and Physics-Informed Machine Learning for Digital Twin, Surrogate Modeling, and Model Discovery, with An Emphasis on Industrial Applications", Computer Modeling in Engineering & Sciences
- Editor, Journal of the Korean Society for Industrial and Applied Mathematics
January 2020 - December 2022

- Guest Editor, Special Issue of "Machine Learning and PDE", Journal of the Korean Society for Industrial and Applied Mathematics
December 2019 - April 2020

Organized Symposia, Workshops, and Conferences:

- POSTECH Mathematics Colloquium, 2018
- Special Session on Scientific Machine Learning, KSIAM fall meeting, 2019
- MINDS Fall Seminar, 2021
- ILJU MINDS Data Science Intensive Research School, 2021
- International Conference on Machine Learning and PDEs: Theory, Algorithms, and Its Applications, 2022
- Physics-Informed Machine Learning Workshop, 2023
- Local Committee in International Conference on Spectral and High Order Methods, 2023
- Minisymposium on Scientific Machine Learning for the Data-driven Discovery of Dynamical Systems, International Conference on Spectral and High Order Methods, 2023
- Minisymposium on Recent Advances in Numerical PDE and Scientific Machine Learning, International Congress on Industrial and Applied Mathematics, 2023
- International Conference on Navier-Stokes Equations and Numerical Analysis, Jan. 2025
- Scientific Machine Learning Workshop, Feb. 2025
- Executive Committee in EASIAM Annual Meeting, Jun. 2025
- Program Committee in Forum Math for Industry, Aug. 2025

Reviewing Activities:

Journal of Computational Physics, SIAM Journal on Scientific Computing, Computer Methods in Applied Mechanics and Engineering, SIAM/ASA Journal on Uncertainty Quantification, International Journal for Uncertainty Quantification, Proceedings of the Royal Society A, Philosophical Transactions of the Royal Society A, Physica D: Nonlinear Phenomena, Journal of the Korean Society for Industrial and Applied Mathematics, Neural Networks, Communications in Computational Physics

MENTORING & ADVISING

PhDs:

Eunsuh Kim, PhD Candidate, POSTECH, 2021-present
Heechang Kim, PhD Candidate, POSTECH, 2022-present
Heejae Kwon, PhD Candidate, POSTECH, 2023-present

MSs:

Dongjoon Lee, MS Candidate, POSTECH, 2024-present

PhDs/MSs Graduated:

Hyomin Shin, PhD, POSTECH, 2024
Sungha Cho, PhD, POSTECH, 2023
Jeahan Jung, PhD, POSTECH, 2023
Yerin Jeon, MS, POSTECH, 2024
Heejae Kwon, MS, POSTECH, 2023
Eunkyu Son, MS, POSTECH, 2021