DONGJIN SEO

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RESEARCH INTERESTS

My research is focused on the intersection of physics and artificial intelligence.
I apply physics to improve AI systems and use AI to advance our understanding and control of physical systems.

- *How can AI be used to design and discover new physical structures? (Inverse Design)*
- *How can AI learn the representation of physical systems? (Physical Inductive Bias)*
- *How can we embed physical systems into AI algorithms? (Physical Neural Networks)*

EDUCATION

[3] **Yale University** — Aug 2024 -
Ph.D. in Applied Physics (Academic Advisor: Prof. Logan G. Wright) — Connecticut, USA

[2] **Korea Advanced Institute of Science and Technology (KAIST)** — Feb 2019 - Feb 2021
M.S. in Electrical Engineering (Academic Advisor: Prof. Min Seok Jang) [thesis] — Daejeon, South Korea

[1] **Korea Advanced Institute of Science and Technology (KAIST)** — Feb 2011 - Feb 2019
B.S. in Electrical Engineering — Daejeon, South Korea
- On Leave Aug 2014 - May 2016 for National Military Service

JOURNAL

[6] Physics-guided and fabrication-aware structural optimization using diffusion models — 2025
D Seo†, S Um†, S Lee, JC Ye*, H Chung*. *ACS Photonics*
[arxiv] [source code]

[5] ASOptimizer^{TM}: optimizing antisense oligonucleotides through deep learning for IDO1 gene regulation — 2024
G Hwang†, M Gwon†, D Seo, DH Kim, K Lee, E kim, M Kang*, J Ryu*. *Molecular Therapy Nucleic Acids*
[paper]

[4] Sample-efficient inverse design of freeform nanophotonic devices with physics-informed reinforcement learning — 2024
C Park†, S Kim†, W Jeong†, J Park, D Seo, Y Kim, C Park, CY Park*, MS Jang*. *Nanophotonics*
[paper]

[3] Adjoint Method in Machine Learning: A Pathway to Efficient Inverse Design of Photonic Devices — 2024
C Kang†, D Seo†, S V Boriskina, H Chung*. *Materials & Design*
[paper]

[2] Structural Optimization of a One-Dimensional Freeform Metagrating Deflector via Deep Reinforcement Learning — 2022
selected as the Front Cover of 2022 Feb. Issue
D Seo†, DW Nam†, J Park, CY Park*, MS Jang*. *ACS Photonics*
[paper] [source code] [press]

[1] Inverse design of organic light-emitting diode structure based on deep neural networks — 2021
S Kim, JM Shin, J Lee, C Park, S Lee, J Park, D Seo, S Park, CY Park, MS Jang*. *Nanophotonics*
[paper]

PREPRINTS

[1] Wave Interpolation Neural Operator: Interpolated Prediction of Electric Fields Across Untrained Wavelengths
J Seo†, C Kang†, D Seo, H Chung.
[arXiv]

CONFERENCE

[9] [poster] Physics-guided Optimization of Photonic Structures using Denoising Diffusion Probabilistic Models — Dec 2024
D Seo†, S Um†, S Lee, J Ye, H Chung. *NeurIPS 2024 Workshop: Machine Learning and the Physical Sciences*
[extended abstract]

[8] [poster] Wave Interpolation Neural Operator: Interpolated Prediction of Electric Fields Across Untrained Wavelengths — Dec 2024
J Seo†, C Kang†, D Seo, H Chung. *NeurIPS 2024 Workshop: Data-driven and Differentiable Simulations*
[extended abstract]

[7] [poster] Adjoint sensitivity analysis based photonic structure efficiency prediction and data augmentation — Aug 2024
C Kang†, D Seo†, S V Boriskina, H Chung. *CLEO-PR 2024*
[proceeding]

[6] [poster] High-Speed Multiwavelength Adjoint Optimization with Surrogate Solver — Aug 2024
J Seo†, C Kang†, D Seo, H Chung. *CLEO-PR 2024*
[proceeding]

[5] [poster] Physics-guided Diffusion Models for Inverse Design — Aug 2024
D Seo†, S Um†, J Ye, H Chung. *CLEO-PR 2024*
[proceeding]

[4] [poster] Contextualized and Aligned Audio-Text Fusion Models for Emotion Recognition — Dec 2023
S Choi, Y Kwon, D Seo. *KCC 2023*
[proceeding]

[3] [oral] Adjoint Method for Data Augmentation of Photonic Structures — Aug 2023
D Seo, C Kang, H Chung. *Optica Imaging Congress*
[proceeding]

[2] [oral] Deep reinforcement learning enables freeform structure optimization of 1D metagrating deflector — Oct 2022
D Seo, DW Nam, J Park, CY Park, MS Jang. *SPIE Optical Engineering + Applications*
[abstract]

[1] [poster] Realization of large scale graphene plasmonic resonator using epsilon-near-zero substrate — Jul 2022
S Kim, S Baek, SY Min, H Ha, D Seo, J Kim, G Lee, B Min, MS Jang. *NANO KOREA 2022*
[abstract]

PATENT

[10] Method and system for psychological test based on brain signal analysis
Korean Patent / Registration No. 10-2741867-0000 / Registration Date 2024.12.13
Inventors: D Seo, T Hwang.

[9] Method and system for interactive psychological test
Korean Patent / Registration No. 10-2738489-0000 / Registration Date 2024.11.29
Inventors: S Choi, D Seo, T Hwang.

[8] Device and method for placing classroom placements using student personality and grade data and machine learning technology
Korean Patent / Registration No. 10-2671422-0000 / Registration Date 2024.05.28
Inventors: S Choi, D Seo, T Hwang.

[7] Method for optimizing classroom structure to achieve maximum learning efficiency utilizing policy-based reinforcement learning
Korean Patent / Registration No. 10-2671423-0000 / Registration Date 2024.05.28
Inventors: D Seo, T Hwang.

[6] Devices, methods and programs for sampling a group of respondents based on artificial intelligence
Korean Patent / Registration No. 10-2663479-0000 / Registration Date 2024.04.30
Inventors: Y Kwon, S Choi, D Seo, T Hwang.

[5] Method and System for Determining Psychological State based on Large Language Model
Korean Patent / Registration No. 10-2624653-0000 / Registration Date 2024.01.09
Inventors: S Choi, D Seo, T Hwang.

[4] Server and Method for Generating Personality Test using Query Response Network based on Language Model
Korean Patent / Registration No. 10-2591769-0000 / Registration Date 2023.10.17
Inventors: Y Kwon, S Choi, D Seo, T Hwang.

[3] Method for Sampling Process of Personality Test Using Question and Answer Network Representing Group of Respondents Based on BERT
Korean Patent / Registration No. 10-2583818-0000 / Registration Date 2023.09.22
Inventors: Y Kwon, S Choi, D Seo, T Hwang.

[2] Method and System for Designing Optimal Sequence of RNA Therapeutics
Korean Patent / Registration No. 10-2546977-0000 / Registration Date 2023.06.20
Inventors: D Seo, M Kang, G Hwang, K Lee.

[1] Method and System for Designing RNA Therapeutics
Korean Patent / Registration No. 10-2499895-0000 / Registration Date 2023.02.09
Inventors: D Seo, M Kang, G Hwang, K Lee.

HONORS AND AWARDS

[7] Kwanjeong Scholarship [website] 2024 - 2030
- Korean scholarship to support doctoral program

[6] 2nd Place of "2023 Corning AI Challenge" [website] Dec 2023

[5] 6th Place of "AI Grand Challenge: Policy Assistance AI" Second Round [press] Dec 2023
- hosted by *the Ministry of Science and ICT of South Korea*
- Position: Team Leader
- Subject: Understanding and creating tables and figures, writing reports with a clear hierarchy using AI

[4] 3rd Place of "AI Grand Challenge: Policy Assistance AI" [website] [press] Jul 2023
- hosted by *the Ministry of Science and ICT of South Korea*
- Position: Team Leader
- Subject: Developing an AI for the interpretation of governmental documents using NLP and CV techniques

[3] 2022 Talent Award of Korea [website] [press] Dec 2022
- Award for talented people in South Korea
- bestowed by *the Deputy Prime Minister and Minister of Education of South Korea*

[2] Best Paper Award (Honorable Mention) [website] Sep 2017
- bestowed by *the School of Humanities & Social Science, KAIST*

[1] Exemplary Soldier Award May 2016
- bestowed by *Senior Superintendent of the Guard of Government Complex Daejeon*
(one person per platoon, Top 5%)

SERVICE

[2] Reviewer at *NeurIPS ML4PS Workshop* 2024

[1] Reviewer for *Nanophotonics* 2024

INVITED TALKS

[3] Invited Talk at McMahon Lab, Cornell University, *Physics-guided and fabrication-aware inverse design using diffusion models* 2 Jul 2025

[2] Invited Talk at KC ML2, *Recent research trends* 25 Jan 2024

[1] Invited Talk at META Research Lab, MIT, *Structural optimization of one-dimensional freeform metagrating deflector via deep reinforcement learning* 9 Jun 2023

TEACHING

[1] Teaching Assistant, *Statistical Methods with Applications in Science and Finance*, Yale University (Fall 2025)