Dohyun Kim (김 도 현)

CONTACT INFORMATION

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APPOINTMENTS

Assistant Professor, Department of Mathematics Education,
Sungkyunkwan University, Seoul, Republic of Korea,
February 2023 – Present.

Assistant Professor, School of Mathematics, Statistics and Data Science,
Sungshin Women's University, Seoul, Republic of Korea,
March 2021 – February 2023. (Department Chair, July 2022 – February 2023.)

Post-doctoral Researcher, Research Institute of Mathematical Sciences,
Seoul National University, Seoul, Republic of Korea,
September 2020 – February 2021.

Post-doctoral Researcher, National Institute for Mathematical Sciences,
Daejeon, Republic of Korea,
March 2019 – September 2020.

EDUCATION

Seoul National University

Ph.D., Mathematics, February 2019

❑ Ph.D. Thesis: *Emergent dynamics of the Schrödinger-Lohe model for quantum synchronization*
❑ Advisor: Prof. Seung-Yeal Ha

Seoul National University

B.S., Mathematics, February 2015

❑ Advisor: Prof. Seung-Yeal Ha

HONOR AND SCHOLARSHIP

❑ **POSCO Science Fellowship of POSCO TJ Park Foundation, Postdoctoral Fellowship,** September 2020.

❑ Brain Korea 21, BK21 Scholarship for a long-term visiting program, July 2017 – August 2017.

Curriculum Vitae, Dohyun Kim, 1, Last Update: April 18, 2024

RESEARCH GRANT	❑ **Basic Science Research Program, NRF (2021R1F1A1055929)**, June 2021 – August 2024. *(Topic: On the modeling, analysis and numerics of a coupled quantum-classical system for emergent dynamics)*
	❑ Start-up Fund, Sungkyunkwan University, March 2023 – February 2025.
	❑ AI Convergence Research Fund, Sungkyunkwan University, April 2023 – August 2023.
RESEARCH INTERESTS	❑ Mathematical analysis for problems arising in physics, engineering, social science, etc.
	❑ Theoretical and numerical analysis of nonlinear Schrödinger equations and quantum hydrodynamics, particularly for dissipative equations.
	❑ Well-posedness, stability and asymptotic analysis of Vlasov/Fokker-Planck equations, particularly on compact manifolds.
	❑ Application of differential equations to control theory: control design for multi-agent systems, mathematical analysis of gradient flows to gradient descent algorithm and nonconvex stochastic optimization for machine learning.

UNDER REVIEW (SUBMITTED)

(*): Corresponding author.

Critical threshold for synchronizability of high-dimensional Kuramoto oscillators under higher-order interactions (with Hyungjin Huh) (Under review)*

On the semiclassical limit of the Schrödinger-Lohe model and concentration estimates (with Seung-Yeal Ha and Gyuyoung Hwang*). (Under review)

Higher-order interaction model from geometric measurements (with Hansol Park* and Woojoo Shim). (Under review) arXiv:2211.13001.

Emergent behavior of the consensus models on the Grassmann manifold (with Jeongho Kim*) (Under review)

Asymptotic convergence of heterogeneous first-order aggregation models: from the sphere to the unitary group (with Hansol Park*) (Under review) arXiv:2206.00984.

Remarks on the minimal α-energy problems (with Hyungjin Huh and Hansol Park*). (Under review)

An algebraic approach for the weak coupling of multiple Lohe tensor models (with Seung-Yeal Ha and Hansol Park*). (Under review). arXiv:2112.14272.

PUBLICATION

On the asymptotic persistency of a bi-cluster flocking in Cucker-Smale ensemble (with Hangjun Cho, Seung-Yeal Ha and Se Eun Noh). To appear in Commun. Pure Appl. Anal.

Emergent behaviors of a non-abelian quantum synchronization model over the unitary group (with Jeongho Kim*). To appear in Eur. J. Appl. Math.

Local synchrony of Kuramoto oscillators on the Cartesian product of two unit circles

(with Hangjun Cho*, Seung-Yeal Ha, Se Eun Noh) To appear in Commun. Math. Sci.

Network structure changes local stability of universal equilibria for swarm sphere model, (with Hyungjin Huh)*. J. Math. Anal. Appl. **538** (2024), 128405.*

Low–dimensional reduction of the non-Abelian quantum synchronization models on the unitary group (with Jeongho Kim*). Kinet. Relat. Models **17** (2024), 436–467.

On the convergence properties of a heterogeneous multi-agent system on the unit sphere. IEEE Trans. Automat. Control **68** (2023), pp. 8301–8307.

Slow and finite-time relaxations to m-bipartite consensus on the Stiefel manifold (Under review). Systems Control Lett. **177** (2023), 105549.

Emergent behaviors of two attractively coupled swarm sphere models with frustration (with Hangjun Cho* and Seung-Yeal Ha). Discrete Contin. Dyn. Syst. B. **28** (2023), pp. 4864–4897.

Uniform stability and emergent dynamics of particle and kinetic Lohe matrix models, (with Seung-Yeal Ha). J. Differential Equations **364** (2023), pp. 181–243.

Collective dynamics of Lohe type aggregation models (with Seung-Yeal Ha). "Modeling and Simulation for Collective Dynamics" (Lecture Notes Series, Institute of Mathematical Sciences, National University of Singapore: Volume 40) https://doi.org/10.1142/13136

On the complete aggregation of the Wigner-Lohe model for identical potentials (with Seung-Yeal Ha and Gyuyoung Hwang*). Netw. Heterog. Media **17** (2022), pp. 665–686.

Two-point correlation function and its applications to the Schrödinger-Lohe type models (with Seung-Yeal Ha and Gyuyoung Hwang*). Quart. Appl. Math. **80** (2022), pp. 669–699.

Existence and emergent dynamics of quadratically separable states to the Lohe tensor model (with Seung-Yeal Ha and Hansol Park*). SIAM J. Appl. Dyn. Syst. **21** (2022).

Stochastic consensus dynamics for nonconvex optimization on the Stiefel manifold: mean-field limit and convergence, (with Seung-Yeal Ha, Myeongju Kang, Jeongho Kim* and Insoon Yang). Math Models Methods Appl. Sci. **32** (2022), pp. 533–617.

On the emergent behavior of the swarming models on the complex sphere (with Jeongho Kim*). Stud. Appl. Math. **148** (2022), pp. 1303–1338.

Emergent behaviors of high-dimensional Kuramoto models on Stiefel manifolds (with Seung-Yeal Ha and Myeongju Kang*). Automatica **136** (2022), 110072.

Complete solvability of the inertial spin model with an averaged spin (with by Hyungjin Huh). Quart. Appl. Math. **80** (2022), pp. 53–67.

Aggregation and disaggregation of active particles on the unit sphere with time-dependent frequencies (with Jeongho Kim*). Discrete Contin. Dyn. Syst. B **27** (2022), pp. 2247–2273.

Cluster synchrony of high-dimensional Kuramoto models with higher-order couplings, SIAM J. Control Optim. **59** (2021), pp.4110–4135.

On the completely separable state for the Lohe tensor model (with Seung-Yeal Ha and Hansol Park). J. Stat. Phys. **183** (2021).*

Synchronization conditions of a mixed Kuramoto ensemble in attractive and repulsive couplings (with Seung-Yeal Ha, Jaeseung Lee and Se Eun Noh). J. Nonlinear Sci. **31** (2021).*

Asymptotic behavior of gradient flows on the unit sphere with various potentials (with Hyungjin Huh). J. Differential Equations **270** (2021), pp. 47–93.*

Constants of motion for the finite-time dimensional Lohe type models with frustration and applications to emergent dynamics, (with Seung-Yeal Ha, Hansol Park and Sang Woo Ryoo). Phys. D **416** (2021), 132781.

A stochastic consensus method for nonconvex optimization on the Stiefel manifold, (with Jeongho Kim, Myeongju Kang, Seung-Yeal Ha and Insoon Yang). 59th IEEE Conference on Decision and Control 2020.

Fast and slow velocity alignments in a Cucker-Smale ensemble with adaptive couplings, (with Seung-Yeal Ha and Jinyeong Park), Commun. Pure Appl. Anal. **19** (2020), pp. 4621–4654.*

Emergence of bi-cluster aggregation for the swarm sphere model with attractive-repulsive couplings, (with Seung-Yeal Ha, Jaeseung Lee and Se Eun Noh), SIAM J. Appl. Dyn. Syst. **19** (2020), pp. 1225–1270.*

State-dependent dynamics of the Lohe matrix ensemble on the unitary group under the gradient flow, SIAM J. Appl. Dyn. Syst. **19** (2020), pp. 1080–1123.*

Emergent behaviors of a first-order particle swarm model on the hyperboloid, (with Seung-Yeal Ha, Seungsu Hwang, Sun-Chul Kim and Chanho Min), J. Math. Phys. **61** (2020), 042701.

Stochastic Lohe matrix model on the Lie group and mean-field limit, (with Jeongho Kim), J. Stat. Phys. **178** (2020), pp. 1467–1514.*

Emergence of orientation flocking for multi-agent system, (with Seung-Yeal Ha, Jaeseung Lee and Se Eun Noh), Discrete Contin. Dyn. Syst. A **40** (2020), pp. 2037–2060.*

Asymptotic behavior of a second-order swarm sphere model and its kinetic limit, Kinet. Relat. Models **13** (2020), pp. 401–434.*

Emergent dynamics of the Lohe matrix ensemble on a network under time-delayed interactions, (with Seung-Yeal Ha, Doheon Kim, Hansol Park and Woojoo Shim), J. Math. Phys. **61** (2020), 012702.

Asymptotic synchronous behavior of the Schrödinger-Lohe system with frustration, (with Seung-Yeal Ha), Nonlinearity **32** (2019), pp. 4609–4637.*

Collective synchronization of the multi-component Gross-Pitaevskii-Lohe system, (with Weizhu Bao, Seung-Yeal Ha and Qinglin Tang), Physica D **400** (2019), 132158.*

Uniform-in-time transition from discrete to continuous dynamics in the Kuramoto synchronization, (with Seung-Yeal Ha, Jeongho Kim and Xiongtao Zhang), J. Math. Phys.

60 (2019), 051508.*

Emergent behavior of a second-order Lohe matrix model on the unitary group (with Seung-Yeal Ha), J. Stat. Phys. **175** (2019), pp. 904–931.*

A second-order swarm model on sphere and its emergent dynamics, (with Seung-Yeal Ha), SIAM J. Appl. Dyn. Syst. **18** (2019), pp. 80–116.*

Emergent dynamics of the inertial spin model with a multiplicative communication weight, (with Seung-Yeal Ha, Doheon Kim and Woojoo Shim), J. Nonlinear Sci. **29** (2019), pp. 1301–1342.

Emergence of aggregation in the swarm sphere model with adaptive coupling law, (with Seung-Yeal Ha, Jaeseung Lee and Se Eun Noh), Kinet. Relat. Models **12** (2019), 411–444.

Particle and kinetic models for swarming particles on a sphere and stability properties, (with Seung-Yeal Ha, Jaeseung Lee and Se Eun Noh), J. Stat. Phys. **174** (2019), 622–655.

Asymptotic behavior and stability for the Schrödinger-Lohe model, (with Seung-Yeal Ha and Hyungjin Huh), J. Math. Phys. **59** (2018), 102701.*

The Wigner-Lohe model for quantum synchronization and its emergent dynamics, (with Paolo Antonelli, Seung-Yeal Ha and Pierangelo Marcati), Netw. Heterog. Media **3** (2017), 403–416.

Emergent behaviors of the Schrödinger-Lohe model on cooperative-competitive networks, (with Seung-Yeal Ha and Hyungjin Huh), J. Differential Equations **263** (2017), 8295–8321.*

TEACHING (AT SKKU)	Spring	2024	Analysis 1 (MAE2007_01) Complex Analysis 2 (MAE3006_01)
	Fall	2023	Analysis 2 (MAE2008_01) Complex Analysis 1 (MAE3001_01)
	Spring	2023	Analysis 1 (MAE2007_01)
TEACHING (AT SSWU)	Fall	2022	Partial Differential Equations and its Applications (CA002600) Advanced Mathematics for Natural Sciences (SA046000) Mathematical Modeling and Differential Equations (CA040700)
	Spring	2022	Introduction to Calculus and Vector Analysis (SA045900) Mathematical Programming (CA061600) Numerical Data Processing (CA061200)
	Fall	2021	Calculus (CA040200) Advanced Mathematics for Natural Sciences (SA046000) Mathematical Modeling and Differential Equations (CA040700)

Spring	2021	Introduction to Calculus and Vector Analysis (SA045900)
		Introduction to Calculus and Vector Analysis (SA045900)
		Introduction to Analysis 1 (CA000500)

CONFERENCE ORGANIZATION

2022 POSCO Sciencefellow Math Symposium, August 23, 2022, co-organized with Young-Pil Choi (Yonsei Univ.) (8 speakers)

Workshop on Mathematical Physics and Probability: Theory and Application, August 8-10, 2022, co-organized with Kyeongsu Choi (KIAS) and Jeongho Kim (KIAS) (20 speakers)

2021 KMS Annual Meeting, Special Session, Nonlinear differential equations from physics and collective behavior, co-organized with Dongnam Ko (The Catholic University of Korea) (8 speakers)

2021 KMS Spring Meeting, Special Session, Nonlinear differential equations from physics and collective behavior, co-organized with Dongnam Ko (The Catholic University of Korea) (8 speakers)

2020 KSIAM Annual Meeting, Special Session, Nonlinear differential equations: modeling of collective motion, co-organized with Dongnam Ko (The Catholic University of Korea) (4 speakers)

CONFERENCE TALKS

Shih-Hsien Fest on Hyperbolic Conservation Laws and Kinetic Theory (A Conference in Honor of Shih-Hsien Yu's 60th Birthday), April 4–5, 2024. (Title: Asymptotic convergence of heterogeneous first-order aggregation models: from the sphere to the unitary group)

One-day workshop on mathematical models: from microscopic to macroscopic scales, December 27, 2023 (Title: On the convergence properties of heterogeneous multi-agent systems on the unit sphere and the unitary group)

2023 The Catholic University Math Seminar, November 2, 2023. (Title: Aggregation on the unit sphere)

ICIAM 2023, August 20–25, 2023. (Title: Asymptotic convergence of heterogeneous first-order aggregation models: from the sphere to the unitary group)

Workshop on Quantum Analysis 2023, July 10–14, 2023. (Title: Asymptotic convergence of heterogeneous first-order aggregation models: from the sphere to the unitary group)

Kinetic Equations In Korea (KEIK), February 15–17, 2023. (Title: Fokker-Planck-type aggregation equations on the sphere and the unitary group)

2022 SAARC PDE Conference, December 27, 2022. (Title: Fokker-Planck-type aggregation equations on the sphere and the unitary group)

2022 POSCO Sciencefellow Math Symposium, August 23, 2022. (Title: Fokker-Planck-type aggregation equations on the sphere and the unitary group)

HY-PDE Workshop, July 18, 2022. (Title: Fokker-Planck-type aggregation equations on the sphere and the unitary group)

RGD 32, July 06, 2022. (Invited talk) (Title: Asymptotic behavior for a coupled system of Schrödinger equations)

2022 Workshop on the Dynamics of Complex Systems, June 29, 2022. (Title: Asymptotic behavior for a coupled system of Schrödinger equations)

PDE Seminar, Hanyang University, May 13, 2022. (Title: Asymptotic behavior for a coupled system of Schrödinger equations)

2022 KMS Spring Meeting, April 28, 2022, Online Meeting. (Title: Asymptotic behavior for a coupled system of Schrödinger equations)

Analysis Seminar for PDE & Applications, July 02, 2021, Webinar, Yonsei University (Title: Asymptotic emergent dynamics of the Schrödinger-Lohe model).

French-Korean IRL in Mathematics, Kinetic and Fluid Equations for Collective Behavior, June 11, 2021, Webinar (Title: Asymptotic emergent dynamics of the Schrödinger-Lohe model).

HY-PDE Workshop, May 27, 2021, Online meeting (Title: Formation of phase-locked states for a coupled system of Schrödinger equations).

Quantized vortices and nonlinear waves, February 19, 2021, Online workshop (Title: Emergence of quantum synchronization for the Schrödinger-Lohe model).

PDE Seminar, Hanyang University, January 13, 2021, Online meeting. (Title: Emergence of consensus on the Stiefel manifold).

2020 KMS Spring Meeting, July 03, 2020, Online meeting. (Title: Asymptotic behavior of a second-order swarm sphere model and kinetic limit) (Invite talk).

~~Quantized vortices and nonlinear waves, March 06, 2020, Osaka city university, Osaka, Japan (Invited talk) (Title: Emergence of quantum synchronization for the Schroödinger-Lohe model) (Cancelled due to COVID-19)~~

PDE seminar, Jan. 09, 2020, Yonsei University, Seoul (Invited talk) (Title: Emergence of synchronous behaviors for the Schrödinger-Lohe model with frustration)

KSIAM Annual Meeting, November 9 2019, Yeosu Venezia Hotel, Yeosu, Korea (Invited talk) (Title: Asymptotic behavior of a second-order swarm sphere model and its kinetic limit)

The 4th meeting of Young Researchers in PDEs, October 11 2019, Hanyang University, Seoul, Korea (Invited talk) (Title: Collective synchronization of the multi-component Gross-Pitaevskii-Lohe system)

Quantum and Kinetic Problems: Modeling, Analysis, Numerics and Applications: Workshop 1: Recent Progress and Challenge in Quantum and Kinetic Problems, October 4 2019, Institute of Mathematical Sciences, National University of Singapore, Singapore (Title: Emergent behaviors of the Schrödinger-Lohe model for quantum synchronization) (Invited talk)

Workshop on Complex Dynamics of Swarm Intelligence, September 7 2019, Seoul National University, Seoul, Korea (jointly with Southern East University) (Title: Emergent

dynamics of an orientation flocking model)

The 7th International Conference on Scientific Computation and Differential Equations, July 23 2019, University of Innsbruck, Innsbruck, Austria (Title: Emergent behaviors of the Schröödinger-Lohe model on cooperative-competitive networks) (Contributed talk)

PDE Seminar, June 4 2019, Inha University, Incheon, Korea (Title: Emergent behavior and uniform stability of a second-order swarm sphere model) (Invited talk)

PDE seminar, May 10 2019, KAIST, Daejeon, Korea (Title: Emergent dynamics of the Schrödinger-Lohe model for quantum synchronization) (Invited talk)

HY-PDE workshop on hyperbolic and kinetic problems, May 6 2019, Hanyang University, Seoul, Korea (Title: Recent progress on the Lohe models) (Invited talk)

Gran Sasso Quantum Meeting: from Many Particle Systems to Quantum Fluids, Nov. 28 2018, Gran Sasso Science Institute, L'Aquila, Italy (Title: Asymptotic behavior and stability problem for the Schrödinger-Lohe model) (Contributed talk)

2018 SKKU-SNU mini-WORKSHOP on Differential Equations, Nov. 16, 2018, Sungkyunkwan University, Suwon, Korea (Title: Emergence of synchronous behaviors for the Schrödinger-Lohe model with frustration) (Invited talk)

2018 Joint meeting of KMS and GMS, Oct. 6, 2018, Coex, Seoul, Korea (Title: Asymptotic behavior and stability problem for the Schrödinger-Lohe model) (Contributed talk)

Modeling, analysis, optimization and control of multi-agent systems, Aug. 7, Harbin Institute of Technology, Harbin, China (Title: Asymptotic behavior and stability problem for the Schrödinger-Lohe model) (Invited talk)

Seminar on particle and kinetic models describing collective behaviors, June 18, 2018, Hanyang University (Title: Asymptotic behavior and stability problem for the Schrödinger-Lohe model) (Invited talk)

East Asian Core Doctorial Forum on Mathematics 2018, Jan. 12, 2018, Tsinghua University, Beijing, China (Title: Emergent behaviors of the Schrödinger-Lohe model on cooperative-competitive networks) (Invited talk)

One day Workshop on Mathematical Modeling of Swarming, Dec. 28, 2017, Inha University, Incheon, Korea (Title: Emergent behaviors of the Schrödinger-Lohe model on cooperative-competitive networks) (Invited talk)

2017 KMS Autumn meeting, Oct. 28, 2017, Dankook University, Cheonan, Korea (Title: Emergent behaviors of the Schrödinger-Lohe model on cooperative-competitive networks) (Invited talk)

PDE Seminar, Mar. 29, 2017, Chung-Ang Univesity, Korea (Title: Quantum Synchronization of the Schroödinger-Lohe model) (Invited talk)

POSTER PRESENTATION — CoPhEE 2023, August 12–14, 2023, Tokyo University, Tokyo, Japan (for the poster presentation) (Title: Emergent dynamics of high-dimensional Kuramoto model on the sphere and unitary group)

ACADEMIC VISITINGS	ICIAM 2023, August 20–25, 2023, Waseda University, Tokyo, Japan (for a contributed talk)
	CoPhEE 2023 (satellite meeting of StatPhys28), August 12–14, 2023, Tokyo University, Tokyo, Japan (for the poster presentation)
	StatPhys28, August 7–11, 2023, Tokyo University, Tokyo, Japan (for the conference)
	~~March 3, 2020 – March 7, 2020, Osaka City University, Osaka, Japan (Cancelled due to COVID-19)~~
	November 17, 2019 – November 23, 2019, Institute of Mathematical Sciences, National University of Singapore, Singapore (for the conference)
	September 29, 2019 – October 5, 2019, Institute of Mathematical Sciences, National University of Singapore, Singapore (for the conference)
	July 21, 2019 – July 28, 2019, University of Innsbruck, Innsbruck, Austria (for the conference)
	February 15, 2019 – February 22, 2019, Sichuan University, Chengdu, China (Host : Prof. Qinglin Tang)
	January 20, 2019 – January 30, 2019, Institute of Mathematics, Academia Sinica, Taipei, Taiwan (Host : Prof. Se Eun Noh)
	November 27, 2018 – December 3, 2018, GSSI, L'Aquila, Italy (for the workshop)
	August 5, 2018 – August 11, 2018, Harbin Institute of Technology, Harbin, China (for the workshop)
	July 12, 2018 – July 23, 2018, Sichuan University, Chengdu, China (Host : Prof. Qinglin Tang)
	July 4, 2018 – July 10, 2018, National Taiwan University, Taipei, Taiwan (for the workshop)
	Jan. 22, 2018 – Feb. 2, 2018, Sichuan University, Chengdu, China (Host : Prof. Qinglin Tang)
	Jan. 11, 2018 – Jan. 17, 2018, Tsinghua University, Beijing, China (for the workshop)
	July 29, 2017 - Aug. 20, 2017, National University of Singapore, Singapore (Host : Prof. Weizhu Bao)
	Feb. 5, 2017 - Feb. 12, 2017, Tohoku University, Sendai, Japan (for the workshop)
	Nov. 2, 2015 - Nov. 13, 2015, Gran Sasso Science Institute, L'Aquila, Italy (Host : Prof. Pierangelo Marcati)
JOURNAL REFEREE	IEEE Transactions on Cybernetics, Systems & Control Letters, Networks and Heterogeneous Media, Journal of Physics A, Scientific Reports, Physica D, New Journal of Physics, IEEE Transactions of Automatic Control, Applied Mathematics and Mechanics, Discrete and Continuous Dynamical Systems, Partial Differential Equations

and Applications, Studies in Applied Mathematics, SIAM Control and Optimization, Communications in Mathematical Sciences, Journal of Functional Analysis, Kinetic and Related Models.

Skills   Languages: Korean (native) / English (fluent both written and spoken language), Chinese (Basic spoken and written language)

Programming Languages: Matlab, Python (major) / C++ (minor)