Seung-Yeon Ryoo

Curriculum Vitae

1200 E California Boulevard, MC 253-37
The Division of Physics, Mathematics and Astronomy
Pasadena CA 91125 USA

sryoo@caltech.edu
http://www.its.caltech.edu/~sryoo/
+1(626)395-3817
Citizenship: Republic of Korea

Employment

- **Olga Taussky and John Todd Postdoctoral Scholar Teaching Fellow in Mathematics** Aug 2023 - current

  Division of Physics, Mathematics and Astronomy, California Institute of Technology, Pasadena, USA

  - Postdoctoral Mentor: Thomas Hutchcroft

Education

- **Ph. D. in Mathematics.** Sep 2018 - May 2023

  Princeton University, New Jersey, USA

  - Thesis advisor: Assaf Naor

  - Thesis title: "On the sharpness of the Assouad embedding theorem for finitely generated groups of polynomial growth and nilpotent Lie groups", available at Proquest.

- **B. Sc. in Mathematics.** Mar 2012 - Feb 2018

  Seoul National University, Seoul, Korea

  - Graduated *Summa Cum Laude* in 2018. GPA 4.26/4.3.

Research Interests

- Bi-Lipschitz and snowflake embeddings of metric spaces into Banach spaces.
- Poincaré inequalities on metric spaces.
- Analysis of mathematical models of synchronization.

Publications

[17] On oscillator death in the Winfree model I: the one-dimensional case. Preprint available at https://arxiv.org/abs/2601.01203

[16] Inertia perturbation theory for the inertial Kuramoto model (with Hangjun Cho, Jiu-Gang Dong, and Seung-Yeal Ha). Preprint available at https://arxiv.org/abs/2508.11241

[15] Quantitative relaxation dynamics from generic initial configuration in the inertial Kuramoto model (with Hangjun Cho, Jiu-Gang Dong, and Seung-Yeal Ha). Preprint available at https://arxiv.org/abs/2503.00720

[14] Asymptotics of Riemannian Lie groups with nilpotency step 2 (with Enrico Le Donne, Sebastiano Nicolussi Golo, and Luca Nalon). Preprint available at https://arxiv.org/abs/2503.00560

[13] Quantitative nonembeddability of groups of polynomial growth into uniformly convex spaces. Preprint available at https://arxiv.org/abs/2207.11305.

[12] Asymptotic formation and orbital stability of phase-locked states in Kuramoto–Lohe type synchronization models on Lie groups. Commun. Math. Sci. **23** 1221–1239 (2025). https://dx.doi.org/10.4310/CMS.250517000730

[11] Embedding snowflakes of Carnot groups into bounded dimensional Euclidean spaces with optimal distortion. Analysis & PDE. **15** 1933–1990 (2022). https://doi.org/10.2140/apde.2022.15.1933

[10] Constants of motion for the Lohe model with frustration and its applications to emergent dynamics (with Seung-Yeal Ha, Dohyun Kim and Hansol Park). Physica D: Nonlinear Phenomena. **416**, 132781 (2021). https://doi.org/10.1016/j.physd.2020.132781

[9] Asymptotic phase-locking dynamics and critical coupling strength for the Kuramoto model (with Seung-Yeal Ha). Commun. Math. Phys. **377** 811-857 (2020). https://doi.org/10.1007/s00220-020-03786-1

[8] On the relaxation dynamics of Lohe oscillators on some Riemannian manifolds (with Seung-Yeal Ha, Dongnam Ko). J. Stat. Phys. **172** 1427-1478 (2018) https://doi.org/10.1007/s10955-018-2091-0

[7] Emergence of partial locking states from the ensemble of Winfree oscillators (with Seung-Yeal Ha, Dongnam Ko, Jinyeong Park). Quart. Appl. Math. **75** 39-68 (2017) https://doi.org/10.1090/qam/1448

[6] Emergent dynamics of a generalized Lohe model on some class of Lie groups (with Seung-Yeal Ha, Dongnam Ko). J. Stat. Phys. **168** 171-207 (2017) https://doi.org/10.1007/s10955-017-1797-8

[5] On the finiteness of collisions and phase-locked states for the Kuramoto model (with Seung-Yeal Ha, Hwa Kil Kim). J. Stat. Phys. **163**, 1394-1424 (2016) https://doi.org/10.1007/s10955-016-1528-6

[4] Emergence of phase-locked states for the Kuramoto model in a large coupling regime (with Seung-Yeal Ha, Hwa Kil Kim). Commun. Math. Sci. **14** 1073-1091 (2016) http://dx.doi.org/10.4310/CMS.2016.v14.n4.a10

[3] On the emergence and orbital stability of phase-locked states for the Lohe model (with Seung-Yeal Ha). J. Stat. Phys. **163**, 411-439 (2016) https://doi.org/10.1007/s10955-016-1481-4

[2] Emergent dynamics of Winfree oscillators on locally coupled networks (with Seung-Yeal Ha, Dongnam Ko, Jinyeong Park). J. Differential Equations **260**, 4203-4236 (2016) https://doi.org/10.1016/j.jde.2015.11.008

[1] Emergence of phase-locked states for the Winfree model in a large coupling regime (with Seung-Yeal Ha, Jinyeong Park). Discrete and Continuous Dynamical Systems **35**, 3417-3436 (2015) http://dx.doi.org/10.3934/dcds.2015.35.3417

Teaching and Grading

- **Instructor at Caltech**

  Ma 109a, Introduction to Geometry and Topology, Fall 2025 (Rating: 4.65/5, Department average: 4.32/5)

  Ma 109c, Introduction to Geometry and Topology, Spring 2025 (Rating: 4.66/5, Department average: 4.44/5)

  Ma 157c, Topics in Geometry and Topology, Spring 2025 (Rating: 4.63/5, Department average: 4.44/5)

  Ma 191a, Selected Topics in Mathematics: Low-Dimensional Embeddings of Doubling Metrics, Fall 2024 (Rating: 4.62/5, Department average: 4.25/5)

  Ma 109c, Introduction to Geometry and Topology, Spring 2024 (Rating: 4.65/5, Department average: 4.25/5)

  Ma 157b, Riemannian Geometry, Spring 2024 (Rating: 4.92/5, Department average: 4.25/5)

- **Teaching Assistant at Princeton University**

  MAT 325, Analysis I: Fourier Analysis and Partial Differential Equations, Spring 2023 (grader)

  MAT 335, Analysis II: Complex Analysis, Fall 2022 (preceptor)

  MAT 325, Analysis I: Fourier Analysis and Partial Differential Equations, Spring 2022 (grader)

  MAT 425, Analysis III: Integration Theory and Hilbert Spaces, Fall 2021 (grader)

  MAT 325, Analysis I: Fourier Analysis and Partial Differential Equations, Spring 2021 (grader)

  MAT 335, Analysis II: Complex Analysis, Fall 2020 (preceptor)

  MAT 325, Analysis I: Fourier Analysis and Partial Differential Equations, Spring 2020 (grader)

  MAT 335, Analysis II: Complex Analysis, Fall 2019 (preceptor)

Seminar/Conference Organization

- **Metric Embeddings** Jul 2025

  Co-organizers: Alexandros Eskenazis (Sorbonne Univ., Univ. of Cambridge), Assaf Naor (Princeton Univ.)

  Location: American Institute of Mathematics, Pasadena, California, USA.

  Homepage: https://aimath.org/pastworkshops/metricembeddings.html

- **Graduate Studnet Seminar** Sep 2019 - May 2020
  Co-organizer: Vikram Giri (Princeton Univ.)
  Location: Princeton University, Princeton, New Jersey, USA.
- **Workshop for Students in Analysis and PDE** Jul 2018
  Co-organizers: Hyunseok Kim (Sogang Univ.), Hyunwoo Kwon (Sogang Univ), Young-Ran Lee (Sogang Univ.)
  Location: Sogang University, Seoul, Korea.
  Homepage: `https://sites.google.com/view/wsap2018`

Honors, Awards, and Fellowships

- **AMS–Simons Travel Grant** Jul 2023
  American Mathematical Society, Simons Foundation
- **Overseas PhD Scholarship** Sep 2018 - Jun 2023
  Korea Foundation for Advanced Studies
- **Centennial Fellowship in the Natural Sciences and Engineering** Sep 2018 - Jun 2022
  Princeton University
- **Grand Prize - 35th University Students' Contest of Mathematics** Dec 2016
  Korean Mathematical Society
- **Undergraduate Scholarship** Sep 2015 - Feb 2018
  Korea Foundation for Advanced Studies
- **Gold Medal, Best Individual Award - 5th International Earth Science Olympiad** Sep 2011
  International Geoscience Education Organization

Referee Work

- Communications in Mathematical Sciences, Dynamical Systems, Journal of Global Optimization, Journal of Statistical Physics, and Nonlinearity.

Outreach

- Organizer for the Gender minorities and Women in Physics, Mathematics and Astronomy program at Caltech 2024-2025
- Diversity Co-Chair of the Caltech Postdoctoral Association 2024-2025

Student Mentored

- Grace To Summer 2025
  Caltech Summer Undergraduate Research Fellowship

Membership in Professional Societies

- American Mathematical Society (AMS)
- Society for Industrial and Applied Mathematics (SIAM)
- Korean Mathematical Society (KMS)

Invited Talks and Visiting Positions

- **A conjectural low-dimensional embedding of doubling metric spaces** Nov 2025
  Functional Analysis in the Pacific Northwest, University of Oregon, Oregon, USA.
- **Group embeddings and coarse differentiation** Oct 2025
  Spectral Gaps, Isaac Newton Institute for Mathematical Sciences, London, UK.

- **Sharpening the Assouad embedding theorem** Oct 2025
  AMS Fall Southeastern Sectional Meeting, Tulane University, New Orleans, USA.
- **Asymptotics of Riemannian Lie groups with nilpotency step 2** Aug 2025
  2025 2K-GATE One day Geometric Topology Festival, Korea Institute for Advanced Studies, Seoul, Korea
- **Sharpening the Assouad embedding theorem** Aug 2025
  Virtual Seminar on Geometry and Topology, Korea Institute for Advanced Studies, Seoul, Korea
- **Visiting Researcher** Aug-Sep 2025
  Korea Institute for Advanced Studies, Seoul, Korea
- **Embedding via heat kernels** Jun 2025
  CRM-PIMS Summer School in Probability, University of British Columbia, Vancouver, British Columbia, Canada.
- **Towards a sharp form of the Assouad embedding theorem** Mar 2025
  Ohio River Analysis Meeting, University of Cincinnati, Cincinnati, Ohio, USA.
- **Quantitative nonembeddability of nilpotent groups into uniformly convex spaces** Mar 2025
  Winter School on Geometric Analysis, Geilo, Norway.
- **Lipschitz Padded Nested Random Partitions** Oct 2024
  20th Prairie Analysis Seminar, University of Kansas, Lawrence, Kansas, USA.
- **Lipschitz Padded Nested Random Partitions** Jul 2024
  Analysis Seminar, Korea Institute for Advanced Studies, Seoul, Korea.
- **Quantitative nonembeddability of nilpotent groups into uniformly convex spaces** Nov 2023
  University of Cincinnati Analysis Seminar, Cincinnati, Ohio, USA.
- **Improving Assouad's theorem on nilpotent groups** Nov 2023
  19th Prairie Analysis Seminar, Manhattan, Kansas, USA.
- **Dorronsoro's theorem and vertical-versus-horizontal inequalities on Carnot groups** Aug 2023
  AWM-MAA Invited Paper Session on Geometric Measure Theory, Harmonic Analysis, and Partial Differential Equations, Tampa, Florida, USA.
- **Embedding finitely generated groups of polynomial growth into Euclidean space** Jul 2023
  Virtual Seminar on Geometry and Topology, Korea Institute for Advanced Studies, Seoul, Korea.
- **Visiting Researcher** Jul 2023
  Korea Institute for Advanced Studies, Seoul, Korea
- **Embedding balls in groups of polynomial growth into Euclidean space** Jun 2023
  Sub-Riemannian Geometry and Beyond III, Centro De Giorgi, Pisa, Italy.
- **On embedding finitely generated groups of polynomial growth into Euclidean spaces** Apr 2023
  Analysis and PDE Seminar, University of California, Los Angeles, Los Angeles, USA.
- **On embedding finitely generated groups of polynomial growth and nilpotent Lie groups into uniformly convex spaces** Dec 2022
  Geometry and Geometric Analysis Working Group, New York University, New York, USA.
- **The correct exponent for the Gotsman–Linial conjecture, after D. Kane** Oct 2022
  Computational Learning Theory and Fourier Analysis, online.
- **Vertical versus horizontal inequalities on nilpotent Lie groups and groups of polynomial growth** Aug 2022
  Dynamics seminar, Seoul National University, Seoul, Korea.

- **Vertical versus horizontal inequalities on nilpotent Lie groups and groups of polynomial growth** Aug 2022
  Virtual Seminar on Geometry and Topology, Korea Institute for Advanced Studies, Seoul, Korea.
- **Vertical versus horizontal inequalities on nilpotent Lie groups and groups of polynomial growth** Aug 2022
  Concentration Week on Geometry and Analysis on Nonsmooth Spaces, Texas A&M University, Texas, USA.
- **A sharp form of the Assouad embedding theorem for Carnot groups** Aug 2022
  Graduate Concentration Week on Metric Geometry, Texas A&M University, Texas, USA.
- **Two mathematical models of synchronization** Apr 2022
  Program in Applied and Computational Sciences Graduate Student Seminar, Princeton University, New Jersey, USA.
- **Vertical versus horizontal inequalities on Carnot groups via a Dorronsoro theorem and Littlewood–Paley–Stein theory** Mar 2022
  AMS Spring Central Virtual Sectional Meeting, Purdue University, Indiana, USA.
- **Dorronsoro's theorem and vertical versus horizontal Poincaré inequalities on Carnot groups** Jan 2022
  Workshop for Young Mathematicians in Korea, Seoul, Korea.
- **Talagrand's influence inequality revisited, after D. Cordero-Erausquin and A. Eskenazis** Oct 2021
  Discrete Analysis and Complexity of Quantum Algorithms, online.
- **A sharp form of Assouad's embedding theorem for Carnot groups** May 2021
  Online Asymptotic Geometric Analysis Seminar, online.
- **A sharp form of Assouad's embedding theorem for Carnot groups** Mar 2021
  AMS Spring Eastern Virtual Sectional Meeting, Brown University, Rhode Island, USA.
- **Embedding snowflakes of Carnot groups into bounded dimensional Euclidean spaces with optimal distortion** Aug 2020
  HYKE-Hwarang Invited Talk, Seoul National University, Seoul, Korea.
- **Embedding metric spaces into ℓ^p** Feb 2020
  Undergraduate ("Nullset") colloquium, Princeton University, New Jersey, USA.
- **Krivine's theorem and related results** Apr 2019
  Graduate Student Seminar, Princeton University, New Jersey, USA.
- **Recent developments in the Assouad embedding theorem** Dec 2018
  Graduate Student Seminar, Sogang University, Seoul, Korea.
- **On the Critical Coupling Strength of the Kuramoto model** Jul 2018
  Workshop for students in Analysis and PDE, Sogang University, Seoul, Korea.
- **Emergent dynamics of a generalized Lohe model on some class of Lie groups** Aug 2017
  Intercollegiate Undergraduate ("Stupid Mathematics") Seminar, Sogang University, Seoul, Korea.
- **The Kuramoto model: a paradigm for synchronization** Aug 2016
  Intercollegiate Undergraduate ("Stupid Mathematics") Seminar, Sogang University, Seoul, Korea.

Other Experience

- **Military Service** Sep 2013 - Sep 2015
  Republic of Korea Air Force