

# Seonghyuk Im(임성혁)

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Student Researcher of IBS ECOPRO

<https://seonghyukim.github.io/>

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## Current Position

- **KAIST** Daejeon, South Korea  
*Integrated master's/doctoral program, Department of Mathematical Sciences* 2021.03-Current  
– Advised by Jaehoon Kim and Hong Liu.
- **IBS ECOPRO** Daejeon, South Korea  
*Student Researcher* 2022.04-Current

## Education

- **KAIST** Daejeon, South Korea  
*B.S., Department of Mathematical Sciences* 2016.03-2020.08
- **Hansung Science High School(한성과학고등학교)** Seoul, South Korea  
*High school education* 2014.03-2016.02

## Research Interests

- Extremal graph theory, especially
  - Embedding spanning structures in dense graphs
  - Homomorphism counting
- Computational complexity of graph problems

## Preprints submitted

- On high discrepancy 1-factorizations of complete graphs (with Jiangdong Ai, Fankang He, Hyunwoo Lee), arXiv:2503.17176
- Ramsey–Dirac theory for bounded degree hypertrees (with Jie Han, Jaehoon Kim, and Donglei Yang), arXiv:2411.17996
- Sidorenko’s conjecture for subdivisions and theta substitutions (with Ruonan Li and Hong Liu), arXiv:2408.03491
- Graph with any rational density and no rich subsets of linear size (with Suyun Jiang, Hong Liu, and Tuan Tran), arXiv:2402.13825
- A bandwidth theorem for graph transversals (with Debsoumya Chakraborti, Jaehoon Kim, and Hong Liu), arXiv:2302.09637

- The proper conflict-free  $k$ -coloring problem and the odd  $k$ -coloring problem are NP-complete on bipartite graphs (with Jungho Ahn and Sang-il Oum), arXiv:2208.08330

## Published

### To appear

- On rainbow Turán Densities of Trees (with Jaehoon Kim, Hyunwoo Lee, and Haesong Seo), arXiv:2312.15956  
To appear in *Random Structures and Algorithms*
- Dirac's theorem for linear hypergraphs (with Hyunwoo Lee), arXiv:2403.14269  
To appear in *SIAM Journal on Discrete Mathematics*

### 2025

- Crux, space constraints and subdivisions (with Jaehoon Kim, Younjin Kim, and Hong Liu)  
*Journal of Combinatorial Theory, Series B* 170 (2025): 82-127.  
arXiv:2207.06653, doi.org/10.1016/j.jctb.2024.08.005. An extended abstract appears in EUROCOMB'23

### 2024

- A proof of the Elliott-Rödl conjecture on hypertrees in Steiner triple systems (with Jaehoon Kim, Joonkyong Lee, and Abhishek Methuku)  
*Forum of Mathematics, Sigma* 2024;12:e75  
arXiv:2208.10370, doi.org/10.1017/fms.2024.34
- On the spectral radius of graphs with given maximum degree and girth (with Jiangdong Ai, Jaehoon Kim, Hyunwoo Lee, Suil O, and Liwen Zhang)  
*Linear Algebra and its Applications* vol 691, 182-195  
doi.org/10.1016/j.laa.2024.03.026

### 2016

- On the mean square displacement of a random walk on a graph (with Hwidong Kim, Jiho Maeng, Jihwan Yu, Yongwook Cha, and Seong-Hun Paeng)  
*European Journal of Combinatorics* 51 (2016): 227-235  
doi.org/10.1016/j.ejc.2015.05.009

## Talks

- 4th East Asia Workshop on Extremal and Structural Graph Theory  
March 29, 2025 at Sun-Yet Sen University (Guangzhou, China)  
*Ramsey-Dirac theory for bounded degree hypertrees*
- (invited) BUPT(Beijing University for Posts and Telecommunications) workshop  
December 15, 2024 at Hainan, China  
*Ramsey-Dirac theory for bounded degree hypertrees*

- (invited) Beijing Institute of Technology(BIT) seminar  
December 10, 2024 at Beijing Institute of Technology (Beijing, China)  
*Almost spanning hypertrees in a Steiner triple system*
- (invited) 2024 KMS Annual Meeting - Special Section: Recent developments in combinatorics  
October 25, 2024 at Sungkyunkwan University (Suwon, South Korea)  
*Sidorenko's conjecture for theta substitutions* (site)
- (invited) Discrete Analysis Seminar  
October 15, 2024 at Yonsei University (Seoul, South Korea)  
*Rainbow Turán Densities of Trees via Graph Limits* (site)
- (invited) Shandong University Seminar  
August 5, 2024, Zoom  
*Rainbow Turán Densities of Trees via Graph Limits*
- 9th European Congress of Mathematics(ECM) - CS-15: 04. Combinatorics and Discrete Mathematics (II)  
July 16, 2024 at Sevilla, Spain  
*Graph with any rational density and no rich subsets of linear size* (site)
- Summit280  
July 11, 2024 at Budapest, Hungary  
*Dirac's theorem for linear hypergraphs* (site)
- 30th British Combinatorial Conference(BCC)  
July 3, 2024 at London, UK  
*Dirac's theorem for linear hypergraphs* (site)
- (invited) 31st KIAS combinatorics workshop  
June 1, 2024 at Jeju, South Korea  
*Dirac's theorem for linear hypergraphs* (site)
- 2024 KMS spring meeting  
April 19, 2024 at Daejeon, South Korea  
*On rainbow Turán densities of trees* (site)
- (invited) Yeungnam University Combinatorics Seminar  
March 18, 2024 at Yeungnam University (Gyeongsan, South Korea)  
*Graph with any rational density and no rich subsets of linear size* (site)
- 2023 European Conference on Combinatorics, Graph Theory and Applications (EUROCOMB'23)  
August 31, 2023 at Prague, Czech Republic  
*Crux, space constraints and subdivisions* (Extended abstract)
- (invited) 2023 KMS Spring Meeting - Special Section: Extremal Combinatorics: Methods and Applications  
April 29, 2023 at Daejeon, South Korea  
*A bandwidth theorem for graph transversals* (site)
- (invited) Shandong University Seminar  
March 30, 2023, Zoom  
*A bandwidth theorem for graph transversals* (Bilibili)

- (invited) IBS Discrete Math Seminar  
November 29, 2022 at IBS (Daejeon, South Korea)  
*A proof of the Elliott-Rödl conjecture on hypertrees in Steiner triple systems* (Youtube)
- KAIST Math Graduate student Seminar (KMGS)  
November 3, 2022 at KAIST (Daejeon, South Korea)  
*Large clique subdivisions in graphs without small dense subgraphs* (site)
- 2021 Combinatorics Workshop  
December 21, 2021 at Yangpyeong, South Korea  
*Large clique subdivisions in graphs without small dense subgraphs* (Youtube)
- (invited) IBS Discrete Math Seminar  
November 30, 2021 at IBS (Daejeon, South Korea)  
*Large clique subdivisions in graphs without small dense subgraphs* (Youtube)

## Teaching

- Mini course: Finding Large Structures (with Hyunwoo Lee)  
Nankai University  
2025 Feb 18-21

## TA works

### 2025

- (spring) CS492 Algorithmic Graph Theory at KAIST

### 2024

- (fall) MAS 477 Introduction to graph theory at KAIST
- (spring) MAS 275 Discrete mathematics at KAIST

### 2023

- (fall) MAS 102 Calculus 2 and MAS 480 Topological methods in combinatorics at KAIST
- (spring) MAS 101 Calculus 1 and MAS 275 Discrete mathematics at KAIST

### 2022

- (fall) MAS 102 Calculus 2 and MAS 477 Introduction to Graph Theory at KAIST
- (spring) MAS 102 Calculus 2 and MAS 275 Discrete mathematics at KAIST

### 2021

- (fall) MAS 102 Calculus 2 and CC511 Probability and Statistics at KAIST
- (spring) MAS 101 Calculus 1 at KAIST (Won the Outstanding Teaching Assistant Award).

## Organizing events

- Co-organizing Deep seminar in combinatorics, 2023-Current ([link](#))
- Co-organizing 2024 KSCW (Korean Student Combinatorics Workshop), 2024 July 29-August 2 ([link](#))
- Co-organizing IBS ECOPRO student reading group, 2022-2023 ([link](#))

## Awards & Honors

**Outstanding TA Award** . . . . . 2021  
*Awarded by KAIST*

**37th Mathematical Contest for University Students - Silver Prize** . . . . . 2018  
*Awarded by Korean Mathematical Society*

**2018 Kakao Code Festival 5th prize (30th place)** . . . . . 2018  
*Awarded by Kakao Corporation*

**36th Mathematical Contest for University Students - Silver Prize** . . . . . 2017  
*Awarded by Korean Mathematical Society*

## Research Visits

- Visited Nankai University, Tianjin, China  
at the invitation of Prof. Jiangdong Ai (February 13-25, 2025 ).
- Visited Beijing University for Posts and Telecommunications Hainan Campus, Hainan, China  
at the invitation of Prof. Luyining Gan (December 11-23, 2024 ).
- Visited Beijing Institute of Technology, Beijing, China  
at the invitation of Prof. Jie Han (December 09-11, 2024 ).
- Visited Nankai University, Tianjin, China  
at the invitation of Prof. Jiangdong Ai (February 16-25, 2024 ).

## References

- **Prof. Jaehoon Kim**  
Department of Mathematical Sciences, KAIST  
[jaehoon.kim@kaist.ac.kr](mailto:jaehoon.kim@kaist.ac.kr)
- **Prof. Hong Liu**  
Extremal Combinatorics and Probability Group, Institute for Basic Science (IBS ECOPRO)  
[hongliu@ibs.re.kr](mailto:hongliu@ibs.re.kr)

## Other manuscripts

- Complexity of Partitioning Hypergraphs, arXiv:1812.09206