Minsuk Kim, Ph.D. (Name in Korean: 김민석; Date of birth: Sep 20, 1991)

F. Widjaja Inflammatory Bowel Disease Institute, Cedars-Sinai Medical Center

8730 Alden Dr, Thalians Building E243, Los Angeles, CA, 90048, United States
Office: +1-310-423-2351 | Phone: +1-507-722-5632
Email: Minsuk.Kim@cshs.org, kms1041@gmail.com
Website: https://sites.google.com/view/minsuk-kim

Professional Experience

03/2022-Present **Project Scientist**
F. Widjaja Inflammatory Bowel Disease Institute,
Cedars-Sinai Medical Center, Los Angeles, CA, USA
(Advisor: Prof. Dermot P. McGovern)

Ongoing project:
- Multi-omics analysis of gut microbiome in inflammatory bowel disease
- Rare variant discovery for familial inflammatory bowel disease using whole-exome/genome sequencing
- Meta-GWAS of human fibrotic diseases across different organs

04/2018-02/2022 **Postdoctoral Research Fellow**
Microbiome Program, Center for Individualized Medicine,
Mayo Clinic, Rochester, MN, USA
(Advisor: Prof. Nicholas Chia & Prof. Jaeyun Sung)

Work summary:
- Community-scale metabolic modeling of gut microbiota for studying its role and functions in health and disease
- Integrative metagenomic-and-metabolomic analysis of gut microbiota for studying early events of colorectal cancer pathogenesis
- Metabolomic analysis of serum and bile samples for characterizing metabolic signatures of primary sclerosing cholangitis
- Single-cell multi-omics data analysis for understanding peripheral immune responses in COVID-19 patients with clonal hematopoiesis of indeterminate potential

03/2017-02/2018 **Postdoctoral Researcher**
Institute of Engineering Research,
Seoul National University, Seoul, Korea
(Advisor: Prof. Byung-Gee Kim)

Education

03/2012-02/2017 **Ph.D. in Biological Engineering** (GPA: 4.09/4.3),
School of Chemical and Biological Engineering,
Seoul National University, Seoul, Korea
Dissertation: "Computational design of microbial strains for nongrowth-associated production of antibiotics and oleochemicals"
(Advisor: Prof. Byung-Gee Kim)

Work summary:
- Metabolic engineering of *Streptomyces* for antibiotic production
- Metabolic engineering of *Yarrowia lipolytica* for biofuel and oleochemical production
- Reconstruction and analysis of genome-scale metabolic models
- Development of new *in silico* strain design algorithms for metabolic engineering
- Integrative analysis of omics data using network models

06/2014-08/2014 **Visiting Researcher**,
Systems Biology and Bioinformatics Group,
Department of Chemical and Biomolecular Engineering,
National University of Singapore, Singapore
(Advisor: Prof. Dong-Yup Lee)

03/2009-02/2012 **B.S. in Biological Engineering**, Summa Cum Laude (GPA: 4.01/4.3),
College of Liberal Studies (자유전공학부),
Seoul National University, Seoul, Korea
(Advisor: Prof. Byung-Gee Kim and Prof. Kyung-Koo Han)

- First to enter and graduate from College of Liberal Studies
- First to design and complete 'student-designed major' in Korea

06/2011-07/2011 **Visiting Student**,
University of California, Los Angeles, CA, USA
(Funded by College of Liberal Studies, Seoul National University)

Research Skills

- Biological network model reconstruction and analysis
- Mathematical modeling of microbial metabolism and interaction
- Computational metabolic engineering
- Statistical analysis of high-throughput biological data
- (Single-cell) multi-omics data analysis and integration

Teaching Experiences

2017 Fall Invited Lecturer, "Applied Biochemistry", Seoul National University
2013 Fall Teaching Assistant, "Applied Biochemistry", Seoul National University
2013 Spring Teaching Assistant, "Chemical Reaction Engineering 1", Seoul National University
2012 Spring Teaching Assistant, "Chemical Reaction Engineering 1", Seoul National University
2011 Fall Teaching Assistant, "Basic Calculus 2", Seoul National University
2011 Spring Teaching Assistant, "Basic Physics 1", Seoul National University
2010 Fall Teaching Assistant, "Basic Calculus 2", Seoul National University
2010 Spring Teaching Assistant, "Basic Physics 1", Seoul National University
Teaching Assistant, "Basic Calculus 1", Seoul National University

Honors, Fellowships and Awards

2012-2016 **Global Ph.D. Fellowship** (>$132,000), National Research Foundation of Korea
2016 **The Best Poster Award**, The 13th International Symposium on the Genetics of Industrial Microorganisms
2015 **Young Scientist Award**, The Korean Society for Biomedical Laboratory Sciences
2014 **Best Paper Award**, Institute of Molecular Biology and Genetics, Seoul National University
2012 **Summa Cum Laude**, College of Liberal Studies, Seoul National University
2009-2011 **National Scholarship for Science and Engineering** (>$17,000), Korea Student Aid Foundation

Journal Responsibilities

2022-Present Review Editor for *Frontiers in Microbiology*

Domestic Media Coverage (국내 언론 보도)

- "내 전공 내가 설계 3년만에..." 자유전공 1호 졸업생 나왔다, 동아일보, 2011.12.06.
- "내 전공 내가 만든다"... 서울대생 2명의 도전, 조선일보, 2010.02.03.

Publications

Journal Papers

1. Moritz Binder, Terra L. Lasho, Wazim Mohammed Ismail, Nana A. Ben-Crentsil, Jenna A. Fernandez, **Minsuk Kim**, Susan M. Geyer, Amelia Mazzone, Christy M. Finke, Abhishek A. Mangaonkar, Jeong-Heon Lee, Kwan Hyun Kim, Vernadette A. Simon, Fariborz Rakhshan Rohakthar, Amik Munankarmy, Susan M. Schwager, Jonathan J. Harington, Melissa R. Snyder, Nathalie M. Droin, Eric Solary, Keith D. Robertson, Eric D. Wieben, Eric Padron, Nicholas Chia, Alexandre Gaspar-Maia, Mrinal M. Patnaik, "Enhancer deregulation in *TET2* mutant clonal hematopoiesis is associated with increased COVID-19 related inflammation severity and mortality" *Under Review*

2. **Minsuk Kim**, Jaeyun Sung, Nicholas Chia, "Resource-allocation constraint governs structure and function of microbial communities in metabolic modeling" *Metabolic Engineering*, 70:12-22 (2022).

3. Vinod K. Gupta, **Minsuk Kim**, Utpal Bakshi, Kevin Y. Cunningham, John M. Davis III, Konstantinos N. Lazaridis, Heidi Nelson, Nicholas Chia, Jaeyun Sung, "A predictive index for health status using species-level gut microbiome profiling" *Nature Communications*, 11:4635 (2020).

4. **Minsuk Kim**[*], Emily Vogtmann[*], David A. Ahlquist, Mary E. Devens, John B. Kisiel, William R. Taylor, Bryan A. White, Vanessa L. Hale, Jaeyun Sung, Nicholas Chia, Rashmi Sinha, Jun Chen ([*]equal contribution), "Fecal metabolomic signatures in colorectal adenoma patients are associated with gut microbiota and early events of colorectal cancer pathogenesis" *mBio*, 11:e03186-19 (2020).

5. **Minsuk Kim**[*], Beom Gi Park[*], Eun-Jung Kim, Joonwon Kim, Byung-Gee Kim ([*]equal contribution), "In silico identification of metabolic engineering strategies for improved lipid production in *Yarrowia lipolytica* by genome-scale metabolic modeling" *Biotechnology for Biofuels*, 12:187 (2019).

6. Pamela S. Tietz-Bogert[*], **Minsuk Kim**[*], Angela Cheung, James H. Tabibian, Julie K. Heimbach, Charles B. Rosen, Madhumitha Nandakumar, Konstantinos N. Lazaridis, Nicholas F. LaRusso, Jaeyun Sung, Steven P. O'Hara ([*]equal contribution), "Metabolomic profiling of portal blood and bile reveals metabolic signatures of primary sclerosing cholangitis" *International Journal of Molecular Sciences*, 19(10):3188 (2018).

7. Joonwon Kim, Hee-Wang Yoo, **Minsuk Kim**, Eun-Jung Kim, Changmin Sung, Pyung-Gang Lee, Beom Gi Park, Byung-Gee Kim, "Rewiring FadR regulon for the selective production of ω-hydroxy palmitic acid from glucose in *Escherichia coli*" *Metabolic Engineering*, 47:414-422 (2018).

8. Pranjul Mishra, Na-Rae Lee, Meiyappan Lakshmanan, **Minsuk Kim**, Byung-Gee Kim, Dong-Yup Lee, "Genome-scale model-driven strain design for dicarboxylic acid production in *Yarrowia lipolytica*" *BMC Systems Biology*, 12(Suppl 2):12 (2018).

9. Jeong Sang Yi, **Minsuk Kim**, Eun-Jung Kim, Byung-Gee Kim, "Production of pikromycin using branched chain amino acid catabolism in *Streptomyces venezuelae* ATCC 15439" *Journal of Industrial Microbiology & Biotechnology*, 45(5):293-303 (2018).

10. **Minsuk Kim**, Beom Gi Park, Joonwon Kim, Jin Young Kim, Byung-Gee Kim, "Exploiting transcriptomic data for metabolic engineering: toward a systematic strain design" *Current Opinion in Biotechnology*, 54:26-32 (2018).

11. Jeong Sang Yi, Min Woo Kim, **Minsuk Kim**, Yujin Jeong, Eun-Jung Kim, Byung-Kwan Cho, Byung-Gee Kim, "A novel approach for gene expression optimization through native promoter and 5' UTR combinations based on RNA-seq, Ribo-seq, and TSS-seq of *Streptomyces coelicolor*" *ACS Synthetic Biology*, 6(3):555-565 (2017).

12. Beom Gi Park[*], **Minsuk Kim**[*], Joonwon Kim, Heewang Yoo, Byung-Gee Kim ([*]equal contribution), "Systems biology for understanding and engineering of heterotrophic oleaginous microorganisms" *Biotechnology Journal*, 12:1600104 (2017).

13. **Minsuk Kim**, Gwanggyu Sun, Dong-Yup Lee, Byung-Gee Kim, "BeReTa: a systematic method for identifying target transcriptional regulators to enhance microbial production of chemicals", *Bioinformatics*, 33(1):87-94 (2017).

14. **Minsuk Kim**, Jeong Sang Yi, Meiyappan Lakshmanan, Dong-Yup Lee, Byung-Gee Kim, "Transcriptomics-based strain optimization tool for designing secondary metabolite overproducing strains of *Streptomyces coelicolor*", *Biotechnology and Bioengineering*, 113(3):651-660 (2016).

15. Changmin Sung, Eunok Jung, Kwon-Young Choi, Jin-hyung Bae, **Minsuk Kim**, Joonwon Kim, Eun-Jung Kim, Pyoung Il Kim, Byung-Gee Kim, "The production of ω-hydroxy palmitic acid using fatty acid metabolism and cofactor optimization in *Escherichia coli*", *Applied Microbiology and Biotechnology*, 99:6667-6676 (2015).

16. Jeong Sang Yi, **Minsuk Kim**, Sung-Jin Kim, Byung-Gee Kim, "Effects of sucrose, phosphate, and calcium carbonate on the productions of pikromycin from *Streptomyces venezuelae*", *Journal of Microbiology and Biotechnology*, 25(4):496-502 (2015).

17. **Minsuk Kim**, Jeong Sang Yi, Joonwon Kim, Ji-Nu Kim, Min Woo Kim, Byung-Gee Kim, "Reconstruction of a high-quality metabolic model enables the identification of gene overexpression targets for enhanced antibiotics production in *Streptomyces coelicolor* A3(2)", *Biotechnology Journal*, 9:1185-1194 (2014).

Abstracts and Posters

1. **Minsuk Kim**, Jaeyun Sung, Nicholas Chia, " Towards in silico gut microbiota model: modeling pairwise microbial interactions in chemostats", *25th Annual Balfour Surgery Research Symposium*, Rochester, MN, USA (2019).

2. **Minsuk Kim**, Emily Vogtmann, David A. Ahlquist, Mary E. Devens, John B. Kisiel, William R. Taylor, Bryan A. White, Vanessa L. Hale, Jaeyun Sung, Nicholas Chia, Rashmi Sinha, Jun Chen, "Gut metabolome of colorectal adenoma patients is associated with gut microbiome and early events of carcinogenesis", *Cold Spring Harbor Laboratory Meetings - Microbiome*, Cold Spring Harbor, NY, USA (2019).

3. **Minsuk Kim**, Jaeyun Sung, Nicholas Chia, "Modeling pairwise microbial interactions in chemostats: can metabolic models answer ecological questions?", *Gordon Research Conference - Microbial Population Biology*, Andover, NH, USA (2019).

4. **Minsuk Kim**, Jun Chen, Vanessa L. Hale, Emily Vogtmann, Rashmi Sinha, Jaeyun Sung, Nicholas Chia, "Fecal metabolomic signatures in colorectal adenomas patients are associated with gut microbiota and early events of colorectal cancer pathogenesis", *24th Annual Balfour Surgery Research Symposium*, Rochester, MN, USA (2018).

5. **Minsuk Kim**, Jun Chen, Vanessa L. Hale, Emily Vogtmann, Rashmi Sinha, Jaeyun Sung, Nicholas Chia, "Linking microbial taxonomic and metabolomic profiles: a case study using stool samples from patients with colorectal adenomas", *International Conference on Microbiome Engineering*, Boston, MA, USA (2018).

6. **Minsuk Kim**, Jeong Sang Yi, Beom Gi Park, Byung-Gee Kim, "Integrated model-based, data-driven design of microbial cell factories for production of antibiotics and oleochemicals", *Data-driven Biotechnology - Bench, Bioreactor and Bedside - Copenhagen Bioscience Conferences*, Copenhagen, Denmark (2017).
7. **Minsuk Kim**, Byung-Gee Kim, "Next generation strain design algorithms using omics data for designing secondary metabolite overproducer", *The 13th International Symposium on the Genetics of Industrial Microorganisms (GIM2016)*, Wuhan, China (2016).
8. **Minsuk Kim**, Jeong Sang Yi, Byung-Gee Kim, "Identifying engineering targets from transcriptomic data using genome-scale metabolic model", *4th Conference on Constraint-Based Reconstruction and Analysis (COBRA)*, Heidelberg, Germany (2015).
9. **Minsuk Kim**, Jeong Sang Yi, Byung-Gee Kim, "Integrative analysis of transcriptomic data into genome-scale model of metabolism results in identification of metabolic engineering targets", *23rd Annual International Conference on Intelligent Systems for Molecular Biology (ISMB) and the 14th European Conference on Computational Biology (ECCB)*, Dublin, Ireland (2015).
10. **Minsuk Kim**, Jeong Sang Yi, Byung-Gee Kim, "Designing antibiotic overproducing strain of *Streptomyces coelicolor* using the model of genome-scale metabolic network", *Network Biology Special Interest Group Meeting - ISMB/ECCB 2015*, Dublin, Ireland (2015).
11. **Minsuk Kim**, Changmin Sung, Jeong Sang Yi, Byung-Gee Kim, "Characterizing an antibiotic overproducing AbsC deletion mutant of *Streptomyces coelicolor* using constraint-based modeling methods", *2015 Spring Meeting and International Symposium of The Korean Society for Biotechnology and Bioengineering (KSBB)*, Yeosu, Korea (2015).
12. **Minsuk Kim**, Jeong Sang Yi, Joonwon Kim, Byung-Gee Kim, "Identifying genetic interventions for antibiotics overproduction using genome-scale metabolic model of *Streptomyces coelicolor*", *2014 Spring Meeting and International Symposium of The Korean Society for Biotechnology and Bioengineering (KSBB)*, Gyeongju, Korea (2014).
13. **Minsuk Kim**, Joonwon Kim, Byung-Gee Kim, "High-quality reconstruction of genome-scale metabolic network for *Streptomyces coelicolor*", *2013 Fall Meeting and International Symposium of The Korean Society for Biotechnology and Bioengineering (KSBB)*, Busan, Korea (2013).
14. **Minsuk Kim**, Byung-Gee Kim, "Transcriptional regulatory network inference for *Streptomyces coelicolor* using modular approach", *2013 Spring Meeting and International Symposium of The Korean Society for Biotechnology and Bioengineering (KSBB)*, Gwangju, Korea (2013).

Invited Talks and Lectures

1. **Minsuk Kim**, “Multi-omics studies of gut microbiome-associated diseases: colorectal cancer and inflammatory bowel disease”, Cancer Research Institute Seminar, College of Medicine, Seoul National University, Seoul, Korea (2023).

2. **Minsuk Kim**, “Multi-omics and modeling approaches for studying gut microbiome-associated diseases” (virtual), Young Researcher Symposium, School of Chemical and Biological Engineering, Seoul National University, Seoul, Korea (2023).
3. **Minsuk Kim**, “Studying gut microbial metabolism: metabolomics & metabolic modeling” (virtual), Clinical & Translational Epidemiology Unit Research Seminar, Massachusetts General Hospital, Boston, MA, USA (2021).
4. **Minsuk Kim**, “Modeling microbial metabolism for health and biotechnological applications” (virtual), Department of Bioengineering, Hanyang University, Seoul, Korea (2021).
5. **Minsuk Kim**, Jaeyun Sung, Nicholas Chia, "Revisiting the definition of ecological interactions in community metabolic modeling studies: current approaches, limitations, and future directions", *3rd International Summer Symposium on Systems Biology (IS3B_2019)*, Mexico City, Mexico (2019).
6. **Minsuk Kim**, "Computational analysis and design of stationary phase metabolism for microbial production of valuable chemicals", Microbiome Program, Center for Individualized Medicine, Mayo Clinic, Rochester, MN, USA (2017).

Contributed Talks

1. **Minsuk Kim**, Jaeyun Sung, Nicholas Chia, "Investigating the implications of resource-allocation constraints in metabolic modeling of gut microbiota", *26th Annual Balfour Surgery Research Symposium*, Rochester, MN, USA (2020).
2. **Minsuk Kim**, Jeong Sang Yi, Byung-Gee Kim, "Advancing metabolic modeling of *Streptomyces* for enhancing antibiotic production", *18th International Symposium on the Biology of Actinomycetes (ISBA18)*, Jeju, Korea (2017).
3. **Minsuk Kim**, Byung-Gee Kim, "Computational identification of transcriptional regulator manipulation targets for microbial production of chemicals", *2016 Spring Meeting and International Symposium of The Korean Society for Biotechnology and Bioengineering (KSBB)*, Gyeongju, Korea (2016).
4. **Minsuk Kim**, Jeong Sang Yi, Byung-Gee Kim, "Computational design of antibiotics overproducers using genome-scale model of metabolism", *2015 Fall Meeting and International Symposium of The Korean Society for Biomedical and Laboratory Sciences (KSBLS)*, Wonju, Korea (2015).
5. **Minsuk Kim**, Jeong Sang Yi, Byung-Gee Kim, "Designing antibiotics overproducers through integrative analysis of transcriptomic data into metabolic model", *30th Anniversary Fall Meeting and International Symposium of The Korean Society for Biotechnology and Bioengineering (KSBB)*, Songdo Convensia, Korea (2015).
6. **Minsuk Kim**, Jeong Sang Yi, Joonwon Kim, Byung-Gee Kim, "Genome-scale metabolic model-guided metabolic engineering of *Streptomyces coelicolor* for antibiotics overproduction", *2014 Fall Meeting and International Symposium of The Korean Society for Biotechnology and Bioengineering (KSBB)*, Changwon, Korea (2014).

References

- **Prof. Byung-Gee Kim, PhD**,
  School of Chemical and Biological Engineering, Seoul National University,
  Email: byungkim@snu.ac.kr

- **Prof. Dermot P. McGovern, MD, PhD**,
  F. Widjaja Inflammatory Bowel Disease Institute, Cedars-Sinai Medical Center,
  Email: Dermot.McGovern@cshs.org

- **Prof. Nicholas Chia, PhD**,
  Department of Surgery, College of Medicine, Mayo Clinic,
  Email: Chia.Nicholas@mayo.edu

- **Prof. Jaeyun Sung, PhD**,
  Department of Surgery, College of Medicine, Mayo Clinic,
  Email: Sung.Jaeyun@mayo.edu

- **Prof. Dong-Yup Lee, PhD**,
  School of Chemical Engineering, Sungkyunkwan University,
  Email: dongyuplee@skku.edu