

MOO SUN HONG

Assistant Professor, Seoul National University | 1 Gwanak-ro, Gwanak-gu, Seoul, 08826, Korea

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EDUCATION

Massachusetts Institute of Technology, Ph.D., Chemical Engineering, 2021

- Thesis: Model-based Design and Control of Biopharmaceutical Manufacturing Processes
- Advisor: Prof. Richard D. Braatz

Massachusetts Institute of Technology, M.S., Chemical Engineering Practice, 2017

Seoul National University, B.S., Chemical and Biological Engineering, 2014

HONORS AND AWARDS

Integrated Continuous Biomanufacturing V Outstanding Poster Presentation Award, ECI, 2022

PD2M Award for Excellence in Integrated QbD Practice, AIChE, 2021

Separations Division Graduate Student Research Award, AIChE, 2021

CAST Directors' Student Presentation Awards Finalist, AIChE, 2021

Modeling, Control, and Optimization of Manufacturing Systems Session Best Presentation, AIChE, 2019

Food, Pharmaceutical & Bioengineering Division Poster Presentation Award, AIChE, 2019

Dow Travel Award, Dow Chemical Company, 2018

Hanwha Travel Award, Hanwha Chemical & Hanwha Total, 2018

Jefferson W. Tester Award, School of Chemical Engineering Practice, MIT, 2016

Overseas Ph.D. Scholarship (\$50K/yr), ILJU Academy and Culture Foundation, 2014–2018

Graduated First in Class, College of Engineering, SNU, 2014

Presidential Science Scholarship, Ministry of Science and Technology, 2008–2014

PROFESSIONAL EXPERIENCE

Assistant Professor, Chemical and Biological Engineering, SNU, Seoul, Korea, 2023–date

Postdoctoral Associate, Chemical Engineering, MIT, Cambridge, MA, 2021–2023

Visiting Research Scientist, Applied Science and Technology, Politecnico di Torino, Torino, Italy, 2019

INVITED TALKS

- [1] Macroscopic modeling of bioreactors for recombinant protein producing *Pichia pastoris* in defined medium. *LabRoots Bioprocessing Virtual Event*, April 8, 2020.
- [2] Model-based control for continuous viral inactivation of biopharmaceuticals. *BioProcess International Europe Conference & Exhibition*, Amsterdam, Netherlands (virtual), July 14, 2020.
- [3] A case study in continuous digital biomanufacturing of monoclonal antibodies. *Continuous Processing in Biopharm Manufacturing, The Bioprocessing Summit*, Boston, MA (virtual), August 25, 2020.
- [4] A case study in continuous digital biomanufacturing of monoclonal antibodies. *Process Characterization & Control, The Bioprocessing Summit*, Boston, MA (virtual), August 28, 2020.
- [5] A case study in applying PAT to the continuous biomanufacturing of monoclonal antibodies. *BioProcess International Conference & Exhibition*, Boston, MA (virtual), September 23, 2020.

- [6] Building a control system pipeline for biopharmaceutical viral inactivation. *MIT Machine Intelligence for Manufacturing and Operations Student Research Forum*, March 4, 2021.
- [7] Model-based control for continuous viral inactivation of biopharmaceuticals. *LabRoots Bioprocessing Virtual Event*, April 7, 2021.
- [8] Mechanistic modeling and parameter-adaptive nonlinear model predictive control of a microbioreactor. *Bioproduction: Scale, Bioreactors & Digitalization, The Bioprocessing Summit*, Boston, MA, August 19, 2021.
- [9] Model-based design and control of biopharmaceutical manufacturing processes. *Young Researcher Symposium, School of Chemical and Biological Engineering, SNU*, Seoul, Korea (virtual), January 6, 2022.
- [10] Process modeling and control of digital biopharmaceutical manufacturing. *Process Control, Optimization, and Data Analytics Young Researcher Online Seminar Series, IEEE CSS TC on Process Control*, January 26, 2022.
- [11] Process modeling and control of digital biopharmaceutical manufacturing. *Smart Digital Engineering Professionals Training Course, Engineering Development Research Center, SNU*, Seoul, Korea (virtual), February 15, 2022.
- [12] Biological validation of column-based continuous viral inactivation. *BioProcess International Europe Conference & Exhibition*, Vienna, Austria (virtual), May 18, 2022.
- [13] Smart Process analytics for the prediction of critical quality attributes in end-to-end batch manufacturing of monoclonal antibodies. *BioProcess International Asia*, April 20, 2023.
- [14] Optimal design and control of advanced biomanufacturing systems, *ST PHARM*, Ansan, Korea, April 20, 2023.
- [15] Optimal design and control of advanced biomanufacturing systems, *KSIEC Spring Meeting*, Jeju, Korea, May 11, 2023.
- [16] Optimal design and control of advanced biomanufacturing systems, *Department of Biological Engineering, Inha University*, Incheon, Korea, May 31, 2023.
- [17] Optimal design and control of advanced biomanufacturing systems, *Advanced Biopharmaceutical Continuous (ABC) Process Workshop*, Incheon, Korea, July 7, 2023.
- [18] Optimal design and control of advanced biomanufacturing systems, *Department of Chemical Engineering and Materials Science, Ewha Womans University*, Seoul, Korea, June 26, 2023.
- [19] Optimal design and control of advanced biomanufacturing systems, *CJ Cheiljedang*, Suwon, Korea, July 5, 2023.
- [20] Optimal design and control of advanced biomanufacturing systems, *School of Chemical Engineering, Sungkyunkwan University*, Suwon, Korea, July 13, 2023.
- [21] Optimal design and control of advanced biomanufacturing systems, *Department of Chemical and Biomolecular Engineering, Korea Advanced Institute of Science and Technology (KAIST)*, Daejeon, Korea, August 7, 2023.
- [22] Smart process analytics for the prediction of critical quality attributes in end-to-end batch manufacturing of monoclonal antibodies, *Smart Biomanufacturing & Digitalization, The Bioprocessing Summit*, Boston, MA, August 17, 2023.
- [23] Model-based design and control of biopharmaceutical manufacturing processes. *SNU-UTokyo Joint Symposium on Chemical Engineering*, Tokyo, Japan, August 21, 2023.

PUBLICATIONS ([Google Scholar](#))

† Equal contribution; * Corresponding author.

Journal Papers

- [1] G. Tian, S. L. Lee, X. Yang, **M. S. Hong**, Z. Gu, S. Li, R. Fisher, and T. F. O'Connor*. A dimensionless analysis of residence time distributions for continuous powder mixing. *Powder Technology*, 315:332-338, 2017.
<https://doi.org/10.1016/j.powtec.2017.04.007>
- [2] **M. S. Hong**, K. A. Severson, M. Jiang, A. E. Lu, J. C. Love, and R. D. Braatz*. Challenges and opportunities in biopharmaceutical manufacturing control. *Computers & Chemical Engineering*, 110:106-114, 2018.
<https://doi.org/10.1016/j.compchemeng.2017.12.007>

- [3] **M. S. Hong**, W. Sun, A. E. Lu, and R. D. Braatz*. Process analytical technology and digital biomanufacturing of monoclonal antibodies. *American Pharmaceutical Review*, 23(6):122-125, 2020 (invited).
- [4] **M. S. Hong** and R. D. Braatz*. Mechanistic modeling and parameter-adaptive nonlinear model predictive control of a microbioreactor. *Computers & Chemical Engineering*, 147:107255, 2021. <https://doi.org/10.1016/j.compchemeng.2021.107255>
- [5] **M. S. Hong**, M. L. Velez-Suberbie, A. J. Maloney, A. Biedermann, K. R. Love, J. C. Love, T. K. Mukhopadhyay, and R. D. Braatz*. Macroscopic modeling of bioreactors for recombinant protein producing *Pichia pastoris* in defined medium. *Biotechnology & Bioengineering*, 118(3):1199-1212, 2021. <https://doi.org/10.1002/bit.27643>
- [6] **M. S. Hong**, K. Kaur, N. Sawant, S. B. Joshi, D. B. Volkin, and R. D. Braatz*. Crystallization of a non-replicating rotavirus vaccine candidate. *Biotechnology & Bioengineering*, 118(4):1750-1756, 2021. <https://doi.org/10.1002/bit.27699>
- [7] A. Gimpel, G. Katsikis, S. Sha, A. J. Maloney, **M. S. Hong**, T. N. T. Nguyen, J. Wolfrum, S. L. Springs, A. J. Sinskey, S. Manalis, P. W. Barone, and R. D. Braatz*. Analytical methods in support of process development for recombinant adeno-associated virus-based gene therapy. *Molecular Therapy — Methods & Clinical Development*, 20:740-754, 2021. <https://doi.org/10.1016/j.omtm.2021.02.010>
- [8] N. J. Mozdierz†, Y. Lee†, **M. S. Hong**†, M. H. P. Benisch, M. L. Rasche, U. E. Tropp, M. Jiang, A. S. Myerson, and R. D. Braatz*. Mathematical modeling and experimental validation of continuous slug-flow tubular crystallization with ultrasonication-induced nucleation and spatially varying temperature. *Chemical Engineering Research and Design*, 169:275-287, 2021. <https://doi.org/10.1016/j.cherd.2021.03.026>
- [9] T. N. T. Nguyen, S. Sha, **M. S. Hong**, A. J. Maloney, P. W. Barone, C. Neufeld, J. Wolfrum, S. L. Springs, A. J. Sinskey, and R. D. Braatz*. Mechanistic model for production of recombinant adeno-associated virus via triple transfection of HEK293 cells. *Molecular Therapy—Methods & Clinical Development*, 21:642-655, 2021. <https://doi.org/10.1016/j.omtm.2021.04.006>
 - Featured on the cover
- [10] **M. S. Hong**†, A. E. Lu†, R. W. Ou, J. Wolfrum, S. L. Spring, A. J. Sinskey, and R. D. Braatz*. Model-based control for column-based continuous viral inactivation of biopharmaceuticals. *Biotechnology & Bioengineering*, 118(8): 3215–3224, 2021. <https://doi.org/10.1002/bit.27846>
 - Featured in *Genetic Engineering & Biotechnology News*, 40(S6):S13-S15, 2020. <https://doi.org/10.1089/gen.40.S6.05>
- [11] **M. S. Hong**, A. E. Lu, A. J. Maloney, R. W. Ou, J. M. Wolfrum, S. L. Springs, A. J. Sinskey, and R. D. Braatz*. Applying PAT to the continuous digital biomanufacturing of monoclonal antibodies. *Pharma Focus Asia*, 44:42-46, 2021 (invited).
- [12] N. J. Mozdierz, **M. S. Hong**, Y. Lee, M. Jiang, A. S. Myerson, and R. D. Braatz*. Tunable protein crystal size distribution via continuous slug-flow crystallization with spatially varying temperature. *CrystEngComm*, 23(37):6495-6505, 2021. <https://doi.org/10.1039/D1CE00387A>
 - Featured on the cover
- [13] **M. S. Hong**, A. E. Lu, J. Bae, J. M. Lee, and R. D. Braatz*. A droplet-based evaporative system for the estimation of protein crystallization kinetics. *Crystal Growth & Design*, 21(11):6064-6075, 2021. <https://doi.org/10.1021/acs.cgd.1c00231>
- [14] P. R. Jeon, **M. S. Hong**, and R. D. Braatz*. Compact neural network modeling of nonlinear dynamical systems via the standard nonlinear operator form. *Computers & Chemical Engineering*, 159:107674, 2022. <https://doi.org/10.1016/j.compchemeng.2022.107674>
- [15] A. Nikolakopoulou†, **M. S. Hong**†, and R. D. Braatz*. Dynamic state feedback controller and observer design for dynamic artificial neural network models. *Automatica*, 146:110622, 2022. <https://doi.org/10.1016/j.automatica.2022.110622>
- [16] **M. S. Hong**, W. Sun, B. W. Anthony, and R. D. Braatz*. Teaching process data analytics and machine learning at MIT. *Chemical Engineering Education*, 56(4):226-230, 2022. <https://doi.org/10.18260/2-1-370.660-130947>

- [17] P. Srisuma, A. Pandit, Q. Zhang, **M. S. Hong**, J. Gamekkanda, F. Fachin, N. Moore, D. Djordjevic, M. Schwaerzler, T. Oyetunde, W. Tang, A. Myerson, G. Barbastathis, and R. D. Braatz*. Thermal imaging-based state estimation of a Stefan problem with application to cell thawing. *Computers & Chemical Engineering*, 173:108179, 2023. <https://doi.org/10.1016/j.compchemeng.2023.108179>

Patents

- [1] **M. S. Hong**, A. E. Lu, and R. D. Braatz. Model-based Control for Column-based Continuous Viral Inactivation of Biopharmaceuticals. W.O. Patent Publication No. WO/2021/222735, April 11, 2021. U.S. Patent Publication No. 2023/0167417 A1, June 1, 2023.

Proceeding Papers

- [1] **M. S. Hong**, K. A. Severson, M. Jiang, A. E. Lu, J. C. Love, and R. D. Braatz. Challenges and opportunities in biopharmaceutical manufacturing control, Sessions on Grand Challenges. *Proceedings of the Foundations of Computer Aided Process Operations / Chemical Process Control*, Paper 117, 2017.
- [2] A. Nikolakopoulou, **M. S. Hong**, and R. D. Braatz. Feedback control of dynamic artificial neural networks using linear matrix inequalities. *Proceedings of the IEEE Conference on Decision and Control*, 2210-2215, 2020. <https://doi.org/10.1109/CDC42340.2020.9303770>
- [3] A. Nikolakopoulou, **M. S. Hong**, and R. D. Braatz. Output feedback control and estimation of dynamic artificial neural networks using linear matrix inequalities. *Proceedings of the American Control Conference*, 2613-2618, 2021. <https://doi.org/10.23919/ACC50511.2021.9483286>

Meeting Abstracts

- [1] H. S. Woo, **M. S. Hong**, S. Shin, T. J. Yoon, and Y.-W. Lee. Regeneration of fatty acid adsorbed γ -alumina using supercritical methanol. *International Symposium on Supercritical Fluids*, Seoul, Korea, October 11–14, 2015. Abstract L-109.
- [2] G. Tian, X. Yang, S. Lee, R. Fisher, S. Li, **M. S. Hong**, Z. Gu, and T. O'Connor. A novel analysis of residence time distributions for continuous powder mixing. *AIChE Annual Meeting*, San Francisco, CA, November 13–18, 2016. Abstract 342g.
- [3] **M. S. Hong** and R. D. Braatz. Mechanistic modeling and parameter-adaptive nonlinear model predictive control of a microbioreactor. *AIChE Annual Meeting*, Pittsburg, PA, October 28–November 1, 2018. Abstract 667e.
- [4] Y. Lee, N. J. Mozdierz, **M. S. Hong**, R. D. Braatz, and W. B. Lee. Mathematical modeling and parameter estimation of continuous tubular crystallizer. *KICHe Spring Meeting*, Jeju, Korea, April 24–26, 2019. Abstract 174.
- [5] **M. S. Hong**, A. E. Lu, and R. D. Braatz. A systematic model-based approach for the design and control of protein crystallization. *AIChE Annual Meeting*, Orlando, FL, November 10–15, 2019. Abstract 29d. **Session Best Presentation.**
- [6] **M. S. Hong**, M. L. Velez-Suberbie, A. J. Maloney, A. Biedermann, K. R. Love, J. C. Love, T. K. Mukhopadhyay, and R. D. Braatz. Macroscopic modeling of bioreactors for recombinant protein producing *Pichia pastoris* in defined medium. *AIChE Annual Meeting*, Orlando, FL, November 10–15, 2019. Abstract 175am.
- [7] **M. S. Hong**, A. E. Lu, J. Bae, J. M. Lee, and R. D. Braatz. A droplet-based evaporative crystallization system for protein crystallization Kinetics Estimation. *AIChE Annual Meeting*, Orlando, FL, November 10–15, 2019. Abstract 558cd.
- [8] **M. S. Hong** and R. D. Braatz. Optimal design and control of advanced biomanufacturing systems. *AIChE Annual Meeting*, San Francisco, CA (virtual), November 15–20, 2020. Abstract 3ci.
- [9] E. M. Cummings Bende, A. J. Maloney, D. Bozinovski, J. Sangerman, A. E. Lu, **M. S. Hong**, N. Persits, A. Artamonova, R. W. Ou, W. Sun, J. Wolfrum, P. W. Barone, R. J. Ram, S. Spring, R. D. Braatz, and A. J. Sinskey. Process development, characterization, and understanding in an integrated continuous monoclonal antibody manufacturing testbed. *AIChE Annual Meeting*, San Francisco, CA (virtual), November 15–20, 2020. Abstract 8e.
- [10] A. Gimpel, G. Katsikis, S. Sha, A. J. Maloney, **M. S. Hong**, T. Nguyen, J. Wolfrum, S. Springs, A. J. Sinskey, S. Manalis, P. W. Barone, and R. D. Braatz. Process analytical technologies for recombinant adeno-associated virus-based gene therapy. *AIChE Annual Meeting*, San Francisco, CA (virtual), November 15–20, 2020. Abstract 157aa.

- [11] **M. S. Hong**, A. E. Lu, and R. D. Braatz. Digitalization of biopharmaceutical manufacturing. *AIChE Annual Meeting*, San Francisco, CA (virtual), November 15–20, 2020. Abstract 195e.
- [12] A. J. Maloney, E. M. Cummings Bende, D. Bozinovski, A. E. Lu, J. Sangerman, **M. S. Hong**, A. Artamonova, R. W. Ou, W. Sun, N. Persits, R. J. Ram, J. Wolfrum, P. W. Barone, S. Spring, A. J. Sinskey, and R. D. Braatz. Process control strategy development for an integrated continuous platform for monoclonal antibody manufacturing. *AIChE Annual Meeting*, San Francisco, CA (virtual), November 15–20, 2020. Abstract 367d.
- [13] **M. S. Hong**, A. E. Lu, A. J. Maloney, E. M. Cummings Bende, D. Bozinovski, J. Sangerman, A. Artamonova, R. W. Ou, P. W. Barone, J. Wolfrum, S. Spring, A. J. Sinskey, and R. D. Braatz. First-principles dynamic simulation of an integrated continuous biomanufacturing platform. *AIChE Annual Meeting*, San Francisco, CA (virtual), November 15–20, 2020. Abstract 542e.
- [14] **M. S. Hong**. Optimal design and control of advanced biomanufacturing systems. *AIChE Annual Meeting*, Boston, MA, November 7–11, 2021. Abstract 4fl.
- [15] **M. S. Hong**, A. E. Lu, J. Bae, J. M. Lee, and R. D. Braatz. Design and control of novel droplet-based system for estimating protein crystallization kinetics. *AIChE Annual Meeting*, Boston, MA, November 7–11, 2021. Abstract 182a.
- [16] W. Sun, F. Mohr, P. R. Jeon, **M. S. Hong**, and R. D. Braatz. Smart process analytics and machine learning. *AIChE Annual Meeting*, Boston, MA, November 7–11, 2021. Abstract 259e.
- [17] D. M. Bozinovski, E. M. Cummings Bende, A. J. Maloney, J. Sangerman, A. B. Dubs, A. E. Lu, **M. S. Hong**, N. Persits, A. Artamonova, R. W. Ou, W. Sun, J. Wolfrum, P. W. Barone, R. J. Ram, S. L. Spring, R. D. Braatz, and A. J. Sinskey. Biomanufacturing and testbed development for the continuous production of monoclonal antibodies. *AIChE Annual Meeting*, Boston, MA, November 7–11, 2021. Abstract 293c.
- [18] **M. S. Hong**, A. E. Lu, R. W. Ou, J. Wolfrum, S. L. Spring, A. J. Sinskey, and R. D. Braatz. Model-based control for column-based continuous viral inactivation of biopharmaceuticals. *AIChE Annual Meeting*, Boston, MA, November 7–11, 2021. Abstract 493c.
- [19] R. D. Braatz, **M. S. Hong**, A. E. Lu, and W. Sun. Keynote talk: Integrated quality by design in (bio)pharmaceutical manufacturing. *AIChE Annual Meeting*, Boston, MA, November 7–11, 2021. Abstract 541d.
- [20] **M. S. Hong** and R. D. Braatz. Process modeling and control of digital biopharmaceutical manufacturing. *AIChE Annual Meeting*, Boston, MA, November 7–11, 2021. Abstract 584a.
- [21] T. N. T. Nguyen, S. Sha, J. Sangerman, **M. S. Hong**, J. Ng, P. W. Barone, C. Neufeld, J. Wolfrum, S. L. Springs, A. J. Sinskey, and R. D. Braatz. *ACS Spring*, San Diego, CA, March 20–24, 2022. Abstract #3652485.
- [22] **M. S. Hong**, A. E. Lu, and R. D. Braatz. Plug-and-play software for mechanistic modelling of end-to-end continuous manufacturing of monoclonal antibodies. *ACS Spring*, San Diego, CA, March 20–24, 2022. Abstract #3653870.
- [23] D. M. Bozinovski, E. M. Cummings Bende, A. J. Maloney, J. Sangerman, A. Dubs, A. E. Lu, **M. S. Hong**, A. Artamonova, R. W. Ou, W. Sun, J. Wolfrum, P. W. Barone, S. L. Springs, R. D. Braatz, and A. J. Sinskey. *ACS Spring*, San Diego, CA, March 20–24, 2022. Abstract #3661909.
- [24] S. H. Kim, **M. S. Hong**, J. H. Lee, and R. D. Braatz. Multiscale computational fluid dynamics method for slug flow reactor simulation. *AIChE Annual Meeting*, Phoenix, AZ, November 13–18, 2022. Abstract 206g.
- [25] **M. S. Hong**, A. E. Lu, and R. D. Braatz. Plug-and-play software for mechanistic modelling of end-to-end continuous manufacturing of monoclonal antibodies. *AIChE Annual Meeting*, Phoenix, AZ, November 13–18, 2022. Abstract 411a.
- [26] **M. S. Hong**, F. Mohr, C. Castro, T. Mistretta, R. A. Hart, B. Smith, and R. D. Braatz. Smart process analytics for the prediction of critical quality attributes in end-to-end batch manufacturing of monoclonal antibodies. *AIChE Annual Meeting*, Phoenix, AZ, November 13–18, 2022. Abstract 567e.

RESIDENT INSTRUCTION

Supervision of Undergraduate Students

- Young Hyun Cho, Taehyeon Kim, Si Yang Park

Supervision of Postdoctoral Fellows/Research Associates

- Yoon Young Choi

Service on Ph.D. Examination Committees

- Dongju Kang (Chemical and Biological Engineering)

Courses Taught

- Process and Product Design (458.401, undergraduate), Spring 2023
- Separation Processes (458.407, undergraduate), Fall 2023

SERVICE TO DISCIPLINARY AND PROFESSIONAL SOCIETIES

Korean Institute of Chemical Engineers (KIChE)

- Member, 2014–date

American Institute of Chemical Engineers (AIChE)

- Member, 2018–date
- Judge, Undergraduate Poster Competition, *AIChE Annual Meeting*, Boston, MA, November 8, 2021
- Judge, Division 15 Poster Competition, *AIChE Annual Meeting*, Boston, MA, November 8, 2021
- Co-chair for Session on Crystallization in Process Development, *AIChE Annual Meeting*, Phoenix, AZ, November 16, 2022

International Federation of Automatic Control (IFAC)

- Affiliate, 2020–date
- Technical Committee on Distributed Parameter Systems (TC 2.6), 2020–date
- Technical Committee on Chemical Process Control (TC 6.1), 2021–date
- Technical Committee on Biological and Medical Systems (TC 8.2), 2021–date

American Chemical Society (ACS)

- Member, 2022–date
- Biochemical Technology (BIOT) Division, 2022–date

Miscellaneous Chairs/Organization

- Scientific Advisory Board, *The Bioprocessing Summit*, Boston, MA, August 15–18, 2022

Reviewer for

- Automatica
- American Control Conference
- IEEE Conference on Decision and Control
- Journal of Process Control
- IFAC World Congress
- ChemEngineering
- Korean Journal of Chemical Engineering
- International Conference on Control, Automation and Systems (ICCAS)
- Processes
- Biotechnology Progress