# CURRICULUM VITAE

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University of Colorado
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## EDUCATION

| | | |
|---|---|---|
| Ph.D. | Chemical Engineering, Carnegie Mellon University (Advisor: Jennifer Sinclair Curtis) | 1996 |
| B.S. | Chemical Engineering, *summa cum laude*, The Ohio State University | 1991 |

## ACADEMIC APPOINTMENTS

| | |
|---|---|
| 2011 – present | Professor, Chemical and Biological Engineering, University of Colorado |
| 2003 – present | Affiliated Faculty, Applied Mathematics, University of Colorado |
| 2013 – 2014 | Visiting Scholar, Chemical and Biological Engineering, University of British Columbia |
| 2005 – 2011 | Associate Professor, Chemical and Biological Engineering, University of Colorado |
| 2006 | Visiting Scholar, Physics, University of Florida |
| 2005 – 2006 | Visiting Scholar, Mechanical and Manufacturing Engineering, Loughborough University |
| 2005 | Visiting Scholar, Kavli Institute of Theoretical Physics, Univ. of California Santa Barbara |
| 1998 – 2005 | Assistant Professor, Chemical and Biological Engineering, University of Colorado |

## EDITORIAL POSITIONS

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|---|---|
| 2015 – present | Associate Editor, *AIChE Journal* |
| 2008 – 2021 | Editor, *Granular Matter* |
| 2013 – 2015 | Editor, *Aerosol Science and Technology* |
| 2012 – 2015 | Consulting Editor, *AIChE Journal* |
| 2002 – 2014 | Editor, AIChE Particle Technology Forum (PTF) Newsletter |

## CONFERENCE CHAIR POSITIONS

| | |
|---|---|
| 2023 | Fluidization XVII, co-chair (Edinburgh, Scotland) |
| 2016 | AIChE Annual Meeting (San Francisco, CA) |
| 2006 | Gordon Conference on Granular and Granular-Fluid Flow (Oxford, UK) |
| 2004 | Patten Centennial Scientific Workshop: The Next Millennium in Chemical Engineering (Boulder, CO) |

## UNIVERSITY LEADERSHIP

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|---|---|
| 2012 – 2015 | Chair, University of Colorado Research Misconduct Committee |
| 2017 – 2019 | Vice Chair, University of Colorado Research Misconduct Committee |

## PROFESSIONAL ORGANIZATION ADVISORY BOARDS

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|---|---|
| 2022 – present | Treasurer, Board of Directors, The Traveling School |
| 2021 – present | Board of Directors, The Traveling School |
| 2019 – present | Advisory Board, Association pour l'Etude de la MicroMécanique des Milieux Granulaires (AEMMG) |
| 2015 | Advisory Board, American Chemical Society Petroleum Research Fund (PRF) |
| 2010 – 2014 | Executive Committee, AIChE Particle Technology Forum (PTF) |
| 2004 – 2008 | Executive Committee, AIChE Particle Technology Forum (PTF) |

## SELECTED HONORS AND AWARDS

| | |
|---|---|
| 2021 | APS Fellow |
| 2020 | AIChE Thomas Baron Award in Fluid-Particle Systems |
| 2014 | AIChE Lectureship Award in Fluidization |
| 2014 | AIChE Particle Technology Forum Service Award |
| 2013 | Boulder Faculty Assembly Award for Excellence in Teaching, CU-Boulder |
| 2013 | Graduate Teaching Award, CU-Boulder Chemical and Biological Engineering |
| 2010 | Hutchinson Memorial Teaching Award, CU-Boulder College of Engineering |
| 2010 | AIChE Particle Technology Forum Best Paper Award |
| 2010 | Graduate Teaching Award, CU-Boulder Chemical and Biological Engineering |
| 2009 – 2010 | Fellow, Emerging Leaders Program, CU-Boulder |
| 2008 | Provost's Faculty Achievement Award, CU-Boulder |
| 2006 | ACS PROGRESS/Dreyfus Lectureship Award |
| 1999 | NSF POWRE Award |
| 1997 | AIChE Best Ph.D. in Particle Technology Award (1997) |

## PLENARY, KEYNOTE, AND DISTINGUISHED TALKS

### *Plenary Conference Presentations*

1. "DEM as a critical tool for understanding particle flows," Particles 2021, Hamburg, Germany, virtual due to covid-19 outbreak (Oct 2021).
2. "Tackling fundamental questions in particle flows, courtesy of industry," Powders and Grains 2021, Buenos Aires, Argentina, virtual due to covid-19 outbreak (Jul 2021).
3. "Using DEM to bridge micro- and macro- flow behavior of cohesive solids," DEM8, Twente, Netherlands (Jul 2019).
4. "Raiding the toolbox to tackle practical issues in particle technology," Fluidization XVI, Guilin, China (May 2019).
5. "Linking Particle Properties to Bulk Flow Behavior," IFPRI Powder Flow Workshop, Amsterdam, The Netherlands (Jan 2017).
6. "Unraveling clustering: Recent progress on the solids-flow instability," International Conference on Multiphase Flows 2016, Florence, Italy (May 2016).

### *Keynote Conference Presentations*

7. "Using a commercial rheometer to determine a particle-particle cohesion model," CHoPS 2022, Salerno, Italy (Jul 2022).
8. "Honoring the band: A sampler of recent hits," Thomas Baron Award Lecture, 2020 AIChE Annual Meeting, virtual due to covid-19 outbreak (Nov 2020).
9. "Theory and Measurements of Large Scale Heterogeneities in Gas-Solid Flows," BIRS-EPIC Workshop, Banff, Canada (Aug 2016).
10. "Clustering Instabilities in Gas-solid Systems: Role of Dissipative Collisions vs. Viscous Losses," Fluidization XIV: From Fundamentals to Products (presented by P. P. Mitrano), Noordwijkerhout, The Netherlands (May 2013).

11. "Polydisperse Gas-Solid Fluidization: Segregation, Bubbles, and Clusters," 6th Sino-U.S. Chemical Engineering Conference, Beijing, China (Nov 2011).

***Distinguished University Seminars***

12. 2020 Jacobus van 't Hoff Lecture, "Learning from the unexpected: Surprising behaviors in particulate systems," Process Technology Institute, Delft University of Technology, The Netherlands, virtual due to covid-19 outbreak (Sep 2020).

13. Edward Silberman Award Lecture: "Attractive couples break up unexpectedly," Saint Anthony Falls Laboratory, University of Minnesota (Nov 2019).

## JOURNAL PUBLICATIONS AND BOOK CHAPTERS

1. Hrenya, C. M., E. J. Bolio, D. Chakrabarti and J. L. Sinclair, "Comparison of Low Reynolds Number k-ε Turbulence Models in Predicting Fully Developed Pipe Flow," *Chemical Engineering Science*, **50**, 1923-1941 (1995).

2. Hrenya, C. M. and J. L. Sinclair, "The Role of Particle-Phase Turbulence in Gas-Solid Flows," *AIChE Journal*, **43**, 853-869 (1997).

3. Hrenya, C., S. Miller, T. Mallo and J. Sinclair, "Comparison of Low Reynolds Number k-□ Turbulence Models in Predicting Heat Transfer Rates for Pipe Flow," *International Journal of Heat and Mass Transfer*, **41**, 1543-1547 (1998).

4. Detamore, M. S., M. A. Swanson, K. R. Frender, and C. M. Hrenya, "A Kinetic-Theory Analysis of the Scale-up of Circulating Fluidized Beds," *Powder Technology*, **116**, 190-203 (2001).

5. Alam, M. and C. M. Hrenya, "Inelastic Collapse in Simple Shear Flow of a Granular Medium," *Physical Review E*, **63**, art. no. 061308, 9 pages (2001).

6. Clelland, R. and C. M. Hrenya, "Simulations of a Binary-sized Mixture of Inelastic Grains in Rapid Shear Flow," *Physical Review E*, **65**, art. no. 031301, 9 pages (2002).

7. Dahl, S. R., R. Clelland, and C. M. Hrenya, "The Effects of Continuous Size Distributions on the Rapid Flow of Inelastic Particles," *Physics of Fluids*, **14**, 1972-1984 (2002).

8. Johnson, J. A., C. M. Hrenya, and A. W. Weimer, "Intrinsic Reaction and Self-Diffusion Kinetics for Silicon Carbide Synthesis by Rapid Carbothermal Reduction," *Journal of the American Ceramic Society*, **85**, 2273-2280 (2002).

9. Johnson, J. A., W. B. Krantz, C. M. Hrenya, and A. W. Weimer, "Sensitivity Analysis of the Rapid Carbothermal Reduction Synthesis of Ultra-Fine Silicon Carbide Powders," *Journal of Aerosol Science and Technology*, **36**, 1087-1098 (2002).

10. Dahl, S. R., C. M. Hrenya, V. Garzó, and J. W. Dufty, "Kinetic Temperatures for a Granular Mixture," *Physical Review E*, **66**, art. no. 041301, 10 pages (2002).

11. Dahl, S. R., R. Clelland, and C. M. Hrenya, "Three-dimensional, Rapid Shear Flow of Particles with Continuous Size Distributions," *Powder Technology*, **138**, 7-12 (2003).

12. Dahl, S. R. and C. M. Hrenya, "Size Segregation in Rapid, Granular Flows with Continuous Size Distributions," *Physics of Fluids*, **16**, 1-13 (2004).

13. Weber, M. W., D. K. Hoffman, and C. M. Hrenya, "Discrete-particle simulations of cohesive granular flow using a square-well potential," *Granular Matter*, **6**, 239-254 (2004).

14. Galvin, J. E., S. R. Dahl, and C. M. Hrenya, "On the role of non-equipartition in the dynamics of rapidly-flowing, granular mixtures," *Journal of Fluid Mechanics*, **528**, 207-232 (2005).

15. Iddir, H., H. Arastoopour, and C. M. Hrenya, "Analysis of binary and ternary granular mixtures using the kinetic theory approach," *Powder Technology*, **151**, 117-125 (2005).

16. Stevens, A. and C. M. Hrenya, "Comparison of soft-sphere models to measurements of collision properties during normal impacts," *Powder Technology*, **154**, 99-109 (2005).

17. Dahl, S. R. and C. M. Hrenya, "Size Segregation in Gas-Solid Fluidized Beds with Continuous Particle Size Distributions," *Chemical Engineering Science*, **60**, 6658-6673 (2005).

18. Walsh, J. K., A. W. Weimer, and C. M. Hrenya, "An experimental study of thermophoretic deposition of aerosol particles in laminar tube flow with mixed convection," *Aerosol Science and Technology*, **40**, 178-188 (2006).

19. Walsh, J. K., A. W. Weimer, and C. M. Hrenya, "Thermophoretic deposition of aerosol particles in laminar tube flow with mixed convection," *Journal of Aerosol Science*, **37**, 715-734 (2006).

20. Hrenya, C. M. and H. Scott Fogler, "Patten Centennial Scientific Workshop: The Next Millennium in Chemical Engineering," *Chemical Engineering Education*, 99-103 (Spring 2006).

21. Weber, M. W. and C. M. Hrenya, "Square-well Model for Cohesion in Fluidized Beds," *Chemical Engineering Science*, **61**, 4511-4527 (2006).

22. Carney, C. S., C. J. Gump, C. M. Hrenya, and A. W. Weimer, "Rapid Nickel Oxalate Thermal Decomposition for Producing Fine Nickel Metal Powders. Part 2: Global Kinetics," *Materials Science and Engineering A*, **431**, 13-25 (2006).

23. Galvin, J. E., C. M. Hrenya, and R. D. Wildman, "On the role of the Knudsen layer in rapid granular flows," *Journal of Fluid Mechanics*, **585**, 73-92 (2007).

24. Weber, M. W. and C. M. Hrenya, "Computational study of pressure-drop hysteresis in fluidized beds," *Powder Technology*, **177**, 170-184 (2007).

25. Garzó, V., C. M. Hrenya, and J. W. Dufty, "Enskog theory for polydisperse granular mixtures. II. Sonine polynomial approximation", *Physical Review E*, **76**, art. no. 031304, 20 pages (2007).

26. Garzó, V., J. W. Dufty, and C. M. Hrenya, and, "Enskog theory for polydisperse granular mixtures. I. Navier-Stokes order transport", *Physical Review E*, **76**, art. no. 031303, 27 pages (2007).

27. Joseph, G. G., J. Leboreiro, C. M. Hrenya, and A. R. Stevens, "Experimental segregation profiles in bubbling gas-fluidized beds," *AIChE Journal*, 53, 2804-2813 (2007).

28. Hrenya, C. M., J. E. Galvin, and R. D. Wildman, "Evidence of higher-order effects in thermally-driven, rapid granular flows," *Journal of Fluid Mechanics*, **598**, 429-450 (2008).

29. Leboreiro, J., G. G. Joseph, and C. M. Hrenya, "Revisiting the standard drag law for bubbling, gas-fluidized beds," *Powder Technology*, **183**, 385-400 (2008).

30. Leboreiro, J., G. G. Joseph, C. M. Hrenya, D. M. Snider, S. S. Banerjee, and J. E. Galvin, "The influence of binary drag laws on simulations of species segregation in gas-fluidized beds," *Powder Technology*, **184**, 275-290 (2008).

31. Donahue, C. M., C. M. Hrenya, A. P. Zelinskaya, and K. J. Nakagawa, "Newton's cradle undone: Experiments and collision models for the normal collision of three solid spheres," *Physics of Fluids*, **20**, art. no. 113301, 11 pages (2008).

32. Kantak, A. A., C. M. Hrenya, and R. H. Davis, "Initial rates of aggregation for dilute, granular flows of wet (cohesive) particles," *Physics of Fluids*, **21**, art. no. 023301, 13 pages (2009).

33. Rice, R. B. and C. M. Hrenya, "Characterization of clusters in rapid granular flows," *Physical Review E*, **79**, art. no. 021304, 9 pages (2009).

34. Henthorn, K. H. and C. M. Hrenya, "Particle cohesion," *Encyclopedia of Chemical Processing*, **1**, 1-8 (2009).

35. Rice, R. B. and C. M. Hrenya, "Clustering in rapid granular flows of binary and continuous particle size distributions," *Physical Review E*, **81**, art. no. 021302, 9 pages (2010).

36. Donahue, C. M., C. M. Hrenya, R. H. Davis, K. J. Nakagawa, A. P. Zelinskaya, and G. G. Joseph, "Stokes' cradle: normal three-body collisions between wetted particles," *Journal of Fluid Mechanics*, **650**, 479-504 (2010).

37. Hrenya, C. M., "Extraction of transport coefficients from molecular dynamics simulations: A perspective," *Industrial & Engineering Chemistry Research*, **49**, 5304-5409 (2010).

38. Tenneti S., R. Garg, C. M. Hrenya, R. O. Fox and S. Subramaniam, "Direct numerical simulation of gas-solid suspensions at moderate Reynolds number: Quantifying the coupling between hydrodynamic forces and particle velocity fluctuations," *Powder Technology*, **203**, 57-69 (2010).

39. Donahue, C. M., C. M. Hrenya, and R. H. Davis, "Stokes's cradle: Newton's cradle with liquid coating," *Physical Review Letters*, **105**, art. no. 034501, 4 pages (2010).

    This work was featured in *Nature* (**466**, 22 July 2010, p. 417) and the *New Scientist* (**2768**, 8 July 2010).

40. Chew, J. W., J. Wolz, and C. M. Hrenya, "Axial segregation in bubbling gas-fluidized beds with Gaussian and lognormal Distributions of Geldart group B particles," *AIChE Journal*, **56**, 3049-3061 (2010).

41. Hrenya, C. M., "Kinetic theory for granular materials: Polydispersity," in *Computational Gas-Solids Flows and Reacting Systems: Theory, Methods and Practice*, S. Pannala, M. Syamlal, and T. O'Brien (eds.), IGI Global, Hershey, PA (2011).

42. Passalacqua, A., J. E. Galvin, P. Vedula, C. M. Hrenya, and R. O. Fox, "A quadrature-based kinetic model for dilute non-isothermal granular flows," *Communications in Computational Physics,* **10**, 216-252 (2011).

43. Hrenya, C. M., "Active Learning in Fluid Mechanics: YouTube Tube Flow and Puzzling Fluids Questions," *Chemical Engineering Education*, **45**, 114-119 (2011).

44. Holloway, W., S. Benyahia, C. M. Hrenya, and S. Sundaresan, "Meso-scale structures of bidisperse mixtures of particles fluidized by a gas," *Chemical Engineering Science*, **66**, 4403-4420 (2011).

45. Chew, J. W., R. Hays, J. G. Findlay, T. M. Knowlton, S. B. R. Karri, R. A. Cocco and C. M. Hrenya, "Species segregation of binary mixtures and a continuous size distribution of Group B particles in riser flow," *Chemical Engineering Science*, **66**, 4595-4604 (2011).

46. Chew, J. W., R. Hays, J. G. Findlay, T. M. Knowlton, S. B. R. Karri, R. A. Cocco and C. M. Hrenya, "Impact of material property and operating conditions on mass flux profiles of monodisperse and polydisperse Group B particles in a CFB riser," *Powder Technology*, **214**, 89-98 (2011).

47. Mitrano, P. P., S. R. Dahl, D. J. Cromer, M. S. Pacella, and C. M. Hrenya, "Instabilities in the homogeneous cooling of a granular gas: A quantitative assessment of kinetic-theory predictions," *Physics of Fluids*, **23**, art. no. 093303, 8 pages (2011).

48. Chew, J. W. and C. M. Hrenya, "Link between bubbling and segregation patterns in gas-fluidized beds with continuous size distributions," *AIChE Journal*, **57**, 3003-3011 (2011).

49. Chew, J. W., D. M. Parker, R. A. Cocco and C. M. Hrenya, "Cluster characteristics of continuous size distributions and binary mixtures of Group B particles in dilute riser flow," *Chemical Engineering Journal*, **178**, 348-358 (2011).

50. Chew, J. W., R. Hays, J. G. Findlay, T. M. Knowlton, S. B. R. Karri, R. A. Cocco and C. M. Hrenya, "Cluster characteristics of Geldart Group B particles in a pilot-scale CFB riser. II. Polydisperse systems," *Chemical Engineering Science*, **68**, 82-93 (2012).

51. Chew, J. W., R. Hays, J. G. Findlay, T. M. Knowlton, S. B. R. Karri, R. A. Cocco and C. M. Hrenya, "Cluster characteristics of Geldart Group B particles in a pilot-scale CFB riser. I. Monodisperse systems," *Chemical Engineering Science*, **68**, 72-81 (2012).

52. Murray, J. A., C. M. Hrenya, and V. Garzó, "Enskog Theory for Polydisperse Granular Mixtures. III. Comparison of dense and dilute transport coefficients and equations of state for a binary mixture," *Powder Technology*, **220**, 24-36 (2012).

53. Chew, J. W., R. Hays, J. G. Findlay, T. M. Knowlton, S. B. R. Karri, R. A. Cocco and C. M. Hrenya, "Reverse Core-Annular Flow of Geldart Group B Particles in Risers," *Powder Technology*, **221**; 1-12 (2012); invited paper for special issue.

54. Mitrano, P.P., V. Garzó, A. M. Hilger, C. J. Ewasko, and C. M. Hrenya, "Assessing a Hydrodynamic Description for Instabilities in Highly Dissipative, Freely Cooling Granular Gases," *Physical Review E*, **85**, art. no. 041303, 5 pages (2012).

55. Wildman, R.D., C. M. Hrenya, J. M. Huntley, T. Leadbeater, D. J. Parker, "Experimental determination of temperature profiles in a sheared granular bed containing two and three sizes of particles," *Granular Matter*, **14**, 215-220 (2012).

56. Donahue, C. M., R. H. Davis, A. A. Kantak, and C. M. Hrenya, "Mechanisms for agglomeration and de-agglomeration following oblique collisions of wet particles," *Physical Review E*, **86**, art. no. 021303, 5 pages (2012).

57. Murray, J.A., S. Benyahia, P. Metzger, and C. M. Hrenya, "Continuum representation of a continuous size distribution of particles engaged in rapid granular flow," *Physics of Fluids*, **24**, art. no. 083303, 19 pages (2012).

58. Donahue, C. M., W. M. Brewer, R. H. Davis, and C. M. Hrenya, "Agglomeration and de-agglomeration of rotating wet doublets," *Journal of Fluid Mechanics*, **708**, 128-148 (2012).

59. Garzó, V., S. Tenneti, S. Subramaniam, and C. M. Hrenya, "Enskog kinetic theory for monodisperse gas-solid flows," *Journal of Fluid Mechanics,* **712**, 129-168 (2012).

60. Chew, J.W., D. M. Parker, and C. M. Hrenya, "Elutriation and species segregation characteristics of polydisperse mixtures of Group B particles in a dilute CFB riser," *AIChE Journal*, **59**, 84-95 (2013).

61. Berger, K. J., A. Anand, P. T. Metzger, and C. M. Hrenya, "Role of collisions in erosion of regolith during a lunar landing," *Physical Review E*, **87**, art. no. 022205, 14 pages (2013).

62. Yin, X., J. R. Zenk, P. P. Mitrano, and C. M. Hrenya, "Impact of collisional vs. viscous dissipation on flow instabilities in gas-solid systems," *Journal of Fluid Mechanics (Rapids)*, **727**, R2, 12 pages (2013).

63. McMillan, J., F. Shaffer, B. Gopalan, J. W. Chew, C. M. Hrenya, R. Hays, S. B. Karri, and R. Cocco, "Particle Cluster Dynamics during Fluidization," *Chemical Engineering Science*, **100**, 39-51 (2013).

64. Mitrano, P. P., S. R. Dahl, A. M. Hilger, C. J. Ewasko, and C. M. Hrenya, "Dual role of friction in granular flows: Attenuation vs. enhancement of instabilities," *Journal of Fluid Mechanics*, **729**, 484-495 (2013).

65. Mitrano, P. P., J. R. Zenk, S. Benyahia, J. E. Galvin, S. R. Dahl, and C. M. Hrenya, "Kinetic-theory predictions of clustering instabilities in granular flows: beyond the small-Knudsen-number regime," *Journal of Fluid Mechanics (Rapids)*, **738**, R2, 12 pages (2014).

    This work was selected as the focus article in Focus on Fluids (*Journal of Fluid Mechanics*, **742**, 1-4, 2014).

66. Mitrano, P. P., V. Garzó, and C. M. Hrenya, "Instabilities in granular binary mixtures at moderate densities," *Physical Review E (Rapid Communication)*, **89,** art. no. 020201R, 5 pages (2014).

67. Liu, P. and C. M. Hrenya, "Challenges of DEM: I. Competing bottlenecks in parallelization of gas-solid flows," *Powder Technology*, **264**, 620-626 (2014).

68. Berger, K. J. and C. M. Hrenya, "Challenges of DEM: II. Wide particle size distributions," *Powder Technology*, **264**, 627-633 (2014).

69. Motlagh, A. H., J. R. Grace, M. Salcudean, and C. M. Hrenya, "New structure-based model for Eulerian simulation of hydrodynamics in gas-solid fluidized beds of Geldart "A" particles" *Chemical Engineering Science*, **120**, 22-36 (2014).

70. Chew, J. W., A. Cahyadi, C. M. Hrenya, R. A. Cocco, R. Kerri, "Review of entrainment correlations in gas-solid fluidization," *Chemical Engineering Journal,* **260**, 152-171, (2015).

71. Berger, K. J., A. Anand, P. T. Metzger, and C. M. Hrenya, "Erratum: Role of collisions in erosion of regolith during a lunar landing," *Physical Review E,* **91**, art. no. 019905, (2015).

72. Cahyadi, A., A. H. Neumayer, C. M. Hrenya, R. A. Cocco, J. W. Chew, "Comparative Study of Transport Disengaging Height (TDH) Correlations in Gas-Solid Fluidization," *Powder Technology* **275**, 220-238 (2015).

73. Morris, A. B., S. Pannala, Z. Ma, and C. M. Hrenya, "A conductive heat transfer model for particle flows over immersed surfaces, *International Journal of Heat and Mass Transfer* **89**, 1277-1289 (2015).

74. LaMarche, C. Q., P. Liu, K. M. Kellogg, A. W. Weimer, "A system-size independent validation of CFD-DEM for non-cohesive particles," *AIChE Journal (Letter)* **61**, 4051-4058 (2015).

75. Fullmer, W. D. and C. M. Hrenya, "Quantitative Assessment of Fine-Grid Kinetic-Theory-Based Predictions of Mean Slip in Unbounded Fluidization," *AIChE Journal (Letter)* **62**, 11-17 (2016).

76. Garzó, V., W. D. Fullmer, C. M. Hrenya, and X. Yin, "Transport coefficients of solid particles immersed in a viscous gas," *Physical Review E* **93**, art. no. 012905, 19 pages (2016).

77. Morris, A. B., Z. Ma, S. Pannala, and C. M. Hrenya, "Simulations of heat transfer to solid particles flowing through an array of heated tubes," *Solar Energy* **130**, 101-115 (2016).

78. Liu, P., C. Q. LaMarche, K. M. Kellogg, and C. M. Hrenya, "Fine particle defluidization: Interaction between cohesion, Young's modulus and static bed height," *Chemical Engineering Science* **145**, 266-278 (2016).

79. Berger, K. J. and C. M. Hrenya, "Impact of a binary size distribution on particle erosion due to an impinging gas plume," *AIChE Journal* **62**, 984-995 (2016).

80. Lattanzi, A. M. and C. M. Hrenya, "A Coupled, Multiphase Heat Flux Boundary Condition for the Discrete Element Method," *Chemical Engineering Journal* **304**, 766-773 (2016).

81. Liu, P., C. Q. LaMarche, K. M. Kellogg, S. Leadley and C. M. Hrenya, "Cohesive grains: Bridging micro-level measurements to macro-level flow behavior via surface roughness," *AIChE Journal (Letter)* **62**, 3529-3537 (2016).

82. LaMarche, C. Q., A. W. Miller, P. Liu, and C. M. Hrenya, "Linking micro-scale predictions of capillary forces to macro-scale fluidization experiments in humid environments," *AIChE Journal* **62**, 3585-3597 (2016).

83. Anantharaman, A., S. B. R. Karri, J. G. Findlay, C. M. Hrenya, R. A. Cocco, J. W. Chew, "Interpreting differential pressure signals for particle properties and operating conditions in a pilot-scale circulating fluidized bed (CFB) riser," *Industrial & Engineering Chemistry Research* **55**, 8659-8670 (2016).

84. Morris, A. B., S. Pannala, Z. Ma, and C. M. Hrenya, "Development of soft-sphere contact models for thermal heat conduction in granular flows," *AIChE Journal* **62**, 4526-4535 (2016).

85. Fullmer, W. D. and C. M. Hrenya, "The clustering instability in rapid granular and gas-solid flows," *Annual Review of Fluid Mechanics* **49**, 485-510 (2017).

86. LaMarche, C.Q., S. Leadley, P. Liu, K. M. Kellogg, C. M. Hrenya, "Method of quantifying surface roughness for accurate adhesive force predictions," *Chemical Engineering Science* **158**, 140-153 (2017).

87. LaMarche, C. Q., P. Liu, K. M. Kellogg, and C. M. Hrenya, "Fluidized-bed measurements of carefully-characterized, mildly cohesive (Group A) particles," *Chemical Engineering Journal* **310**, 259-271 (2017).

88. Anantharaman, A., A. Issangya, S. B. R. Karri, J. Findlay, C. M. Hrenya, R. A. Cocco, J. W. Chew, "Annulus flow behavior of Geldart Group B particles in a pilot-scale CFB riser," *Powder Technology* **35**, 816-828 (2017).

89. Fullmer, W. D. and C. M. Hrenya, "Are Continuum Predictions of Clustering Chaotic?" *Chaos* **27**, art. no. 031101, 8 pages (2017).

90. Liu, P., C. Q. LaMarche, K. M. Kellogg, and C. M. Hrenya, "Dense vs. dilute fluidization of cohesive particles: Reverse sensitivity to friction and restitution coefficient, " *Physical Review Fluids* **2**, art. no. 054302, 20 pages (2017).

91. Fullmer, W. D., G. Liu, X. Yin and C. M. Hrenya, "Clustering instabilities in sedimenting fluid-solid systems: Critical assessment of kinetic-theory-based predictions using DNS data," *Journal of Fluid Mechanics* **823**, 433-469 (2017).

92. Berger, K. J. and C. M. Hrenya, "Predicting regolith erosion during a lunar landing: Role of a continuous size distribution," *Journal of Aerospace Engineering* **30**, art. no. 04017027, 10 pages (2017).

93. Liu, P., K. M. Kellogg, C. Q. LaMarche, and C. M. Hrenya, "Dynamics of singlet-doublet collisions of cohesive particles," *Chemical Engineering Journal* **324**, 380-391 (2017).

94. R. Cocco, W. D. Fullmer, P. Liu, and C. M. Hrenya, "CFD-DEM: Modeling the small to understand the large," *Chemical Engineering Progress* (Sep 2017).

    This work was featured as cover art on issue.

95. Lattanzi, A. M. and C. M. Hrenya, "Indirect Conduction in Gas-Solids Systems: Static vs. Dynamic Effects," *AIChE Journal* **63**, 4685-4693 (2017).

96. LaMarche, C. Q., A. W. Miller, P. Liu, S. Leadley, and C. M. Hrenya, "How nano-scale roughness impacts the flow of grains influenced by capillary cohesion," *AIChE Journal* **63**, 5250-5257 (2017).

97. Cocco, R. A., S.B. Reddy Karri, T. M. Knowlton, J. Findlay, T. Gauthier, J. W. Chew and C. M. Hrenya, "Intrusive Probes in Riser Applications," *AIChE Journal* **63,** 5361-5374 (2017).

98. Sundaresan, S., C. M. Hrenya, M. P. Harold, and J. S. Curtis, "A Tribute to Roy Jackson," *AIChE Journal* **63,** 5238 (2017).

99. Kellogg, K. M., P. Liu, C. Q. LaMarche, and C. M. Hrenya, "Continuum Theory for Rapid, Cohesive-Particle Flows: General Balance Equations and DEM-based Closure of Cohesion-specific Quantities," *Journal of Fluid Mechanics* **832**, 345-382 (2017).

100. Fullmer, W. D. and C. M. Hrenya, "The homogeneous cooling state as a verification test for kinetic-theory-based continuum models of gas-solid flows," *Journal of Verification, Validation and Uncertainty Quantification* **2**, art. no. 044501, 5 pages (2017).

101. Fullmer, W. D. and C. M. Hrenya, "Continuum prediction of scale-dependent, anisotropic fluctuating kinetic energy in gas-solid flows," *Chemical Engineering Science* **186**, 84-87 (2018).

102. Liu, P., C. Q. LaMarche, K. M. Kellogg and C. M. Hrenya, "A square-force cohesion model and its extraction from bulk measurements," *AIChE Journal* **64**, 2329-2339 (2018).

    This work was selected as the Editor's Choice article for this issue.

103. Fullmer, W. D., C. Q. LaMarche, A. Issangya , P. Liu, R. Cocco and C. M. Hrenya, "Experimental Data for Code Validation: Horizontal Air Jets in a Semicircular Fluidized Bed of Geldart Group D Particles," *AIChE Journal* **64**, 2351-2363 (2018).

104. Liu, P. and C. M. Hrenya, "Cluster-induced Deagglomeration in Dilute Gravity-driven Gas-solid Flows of Cohesive Grains," *Physical Review Letters* **121**, art. no. 238001, 7 pages (2018).

105. Lattanzi, A.M., X. Yin and C. M. Hrenya, "A fully developed boundary condition for the random walk particle tracking method," *International Journal of Heat and Mass Transfer* **131**, 604-610 (2019).

106. Kellogg, K. M., P. Liu and C. M. Hrenya, "Continuum prediction of entrainment rates and agglomeration of gas-fluidized, lightly-cohesive particles," *Chemical Engineering Science* **199**, 249–257 (2019).

107. Lattanzi, A. M., X. Yin, and C. M. Hrenya, "A Hybrid Lattice Boltzmann - Random Walk Method for Heat Transfer in Gas-Solids Systems," *Journal of Computational Physics: X* **1**, art. no. 100007, 23 pages (2019).

108. Mishra, I., A. M. Lattanzi, C. Q. LaMarche, A. B. Morris and C. M. Hrenya, "Experimental validation of indirect conduction theory and effect of particle roughness on wall-to-particle heat transfer," *AIChE Journal* **65**, e16703, 13 pages (2019).

109. Fullmer, W. D., J. E. Higham, C. Q. LaMarche, A. Issangya, R. Cocco, C. M. Hrenya, "Comparison of Velocimetry Methods for Horizontal Air Jets in a Semicircular Fluidized Bed of Geldart Group D Particles," *Powder Technology* **359**, 323–330 (2020).

110. Mishra, I., P. Liu, A. Shetty, and C. M. Hrenya, "On the use of a powder rheometer to probe defluidization of cohesive particles," *Chemical Engineering Science* **214,** 115422, 10 pages (2020).

111. Lattanzi, A. M., X. Yin and C. M. Hrenya, "Heat and Momentum Transfer to a Particle in a Laminar Boundary Layer," *Journal of Fluid Mechanics* **889**, A6, 40 pages (2020).

112. Sitaraman, H., D. Vaidhynathana, R. Grout, T. Hauser, C. M. Hrenya, and J. Musser, "An error-controlled adaptive time-stepping method for particle advancement in coupled CFD-DEM simulations," *Powder Technology* **379**, 203-216 (2021).

113. LaMarche, W. C. Q., P. Liu, K. M. Kellogg, A. M. Lattanzi and C. M. Hrenya, "Toward general regime maps for cohesive-particle flows: Force vs. energy-based descriptions and relevant dimensionless groups," *AIChE J.* **67**, e17337, 16 pages (2021).

    This work was selected as the Editor's Choice article for this issue.

114. Dahl, S. R., W. C. Q. LaMarche, P. Liu, W. D. Fullmer, and C. M. Hrenya, "Toward reducing uncertainty quantification costs in DEM models of particulate flow: Testing simple, sensitivity-based, forward uncertainty propagation techniques," *Powder Technology* **398**, 117136, 12 pages (2022).

115. LaMarche, W. C. Q., S. R. Dahl, W. D. Fullmer, and C. M. Hrenya, "Very small-scale experiments of particle segregation in a fluidized bed: A dataset for CFD-DEM model validation and uncertainty quantification ," *AIChE Journal* **68**, e17643, 14 pages (2022).

116. Mishra, I., M. J. Molnar, M. Y. Hwang, A. Shetty, and C. M. Hrenya, "Experimental validation of the extraction of a particle-particle cohesion model (square-force) from simple bulk measurements (defluidization in a rheometer)," *Chemical Engineering Journal* **259**, 117782, 12 pages (2022).

117. LaMarche, C. Q., R. Cocco, S. B. Reddy Karri, S. R. Dahl and C. M. Hrenya, "Experimental measurements of gas-particle flows in large-scale strippers," *Chemical Engineering Science* **264**, 118087 (2022).

118. Vaidhynathan, D., H. Sitaraman, R. Grout, T. Hauser, C. Hrenya, and J. Musser, "Memory access optimization for particle operations in computational fluid dynamics-discrete element method simulations ," *Particuology* (in press).

119. Kellogg, K. M., P. Liu and C. M. Hrenya, "DEM-based determination of particle-level inputs for continuum theory of flows with moderately-cohesive particles," (under review).

## INVITED TALKS

### *Academia*

1. "The Role of Particle-Phase Turbulence in Dense Gas-Solid Flows," Department of Chemical Engineering and Materials Science, University of Minnesota (Jan 1996).
2. "Predicting Dense Gas-Solid Flows in Vertical Tubes," Department of Chemical and Environmental Engineering, University of Arizona (Feb 1996).
3. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Department of Chemical Engineering, The Ohio State University (Feb 1998).
4. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Department of Chemical Engineering, University of Colorado (Feb 1998).
5. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Department of Chemical Engineering, University of Houston (Mar 1998).
6. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Department of Applied Mathematics, University of Colorado (Sep 1998).
7. "The Flow Behavior of Massive Particles: Explainable and (currently) Unexplainable Phenomena," Institute of Process Engineering, ETH, Zurich (Jul 1999).
8. "Modeling and Scale-Up of High-Velocity, Gas-Solid Systems," Department of Chemical Engineering, Colorado State University (Oct 1999).
9. "Effects of Scale-Up and Polydispersity in Fluidized Gas-Solid Systems," Department of Mechanical Engineering, Iowa State University (Mar 2000).
10. "Molecular-Dynamics Simulations of Rapid Granular Flows and their Implications on the Kinetic Theory Approach," School of Chemical Engineering, Purdue University (Sep 2000).
11. "Molecular-Dynamics Simulations of Rapid Granular Flows and their Implications on the Kinetic Theory Approach," Ferroelectric Liquid Crystal Materials Research Center, Department of Physics, University of Colorado (Dec 2000).
12. "Rheology of Rapid Flows with Multi-sized or Cohesive Grains," Department of Chemistry, Iowa State University (Oct 2001).
13. "Toward an Understanding of the Effects of Polydispersity in Particulate Flows," Department of Chemical Engineering, Lehigh University (Oct 2002).
14. "Computational Tools to investigate the Flow Behavior of Particulate Systems," Department of Applied Mathematics, University of Colorado (Mar 2003).
15. "Observations on mixing and de-mixing in rapid flows of unlike particles," Sibley School of Mechanical and Aerospace Engineering, Cornell University (Oct 2003).
16. "On the Rheology of Solids with Nonuniform Size and/or Density," Department of Chemical Engineering, Carnegie Mellon University (Mar 2004).
17. "On the Rheology of Solids with Nonuniform Size and/or Density," Department of Chemical Engineering, Illinois Institute of Technology (Apr 2004).

18. "The Effect of Size Distribution on a Clustering Instability in Granular Gases," Department of Chemical and Biochemical Engineering, Rutgers University (Sep 2005).
19. "Mixing and Segregation in Granular Flows," Department of Chemical Engineering, University of Florida (May 2006).
20. "Transport Phenomena in Particulate Systems," Department of Chemical and Biological Engineering, University of Colorado (Dec 2006).
21. "Cohesive Forces in Gas-Solid Flows," School of Chemical Engineering, Purdue University (Jan 2007).
22. "Evidence of higher-order effects in thermally driven granular flows," The James Franck Institute, University of Chicago (Apr 2007).
23. "Newton's Cradle Undone: Experiments and Theory for Collisions between Wetted Solids," Department of Chemical and Petroleum Engineering, University of Pittsburgh (Dec 2008).
24. "Exploring Wetted Particle Collisions with Stokes' Cradle," Max Planck Institute, Göttingen, Germany (Jun 2009).
25. "Landing Spacecraft on the Moon, Manufacturing Pills, and Feeding Chickens: What is the Common Thread?," Chancellor's CU Seminar, University of Colorado (Apr 2010).
26. "Stokes' Cradle and Beyond: Using Toys to Probe the Physics of Wetted-particle Agglomeration," New Jersey Institute of Technology, Department of Mechanical and Industrial Engineering (Mar 2011).
27. "Stokes' Cradle and Beyond: Using Toys to Probe the Physics of Wetted-particle Agglomeration," Arizona State University, School for Engineering of Matter, Transport and Energy (Apr 2011).
28. "Bouncing, sticking, and spinning: The agglomeration behavior of wetted particles," Princeton University, Department of Chemical and Biological Engineering (May 2012).
29. "Hydrodynamics of Gas-Solid Flows with a Continuous Size Distribution: Experiments and Theory," Oklahoma University, School of Chemical, Biological, and Materials Engineering (Sep 2012).
30. "Recent Progress in Granular and Gas-solid Flows: Polydispersity, Cohesion, and Clustering," University of British Columbia, Department of Chemical and Biological Engineering (Feb 2013).
31. "Instabilities in Flows of Solid Particles," Department of Applied Mathematics, University of Colorado (Feb 2013).
32. "Dynamics of Wetted-particle Collisions," Department of Applied Mathematics, University of Colorado (Sep 2013).
33. "Wetted-particle Collisions: Experiments and Theory," Department of Chemical and Environmental Engineering, University of Arizona (Nov 2013).
34. "Instabilities in particle flows: Unraveling a smattering of surprising observations," Department of Mechanical Engineering, Iowa State University (Mar 2014).
35. "Clusters, streaks, and vortices: Understanding the flow instabilities unique to granular materials," Mechanical Engineering Department, University of Minnesota (Oct 2014).
36. "Using Computation in Design of Novel Concentrating Solar Power Receiver," Enabling Processing Innovation through Computation (EPIC) Workshop, Louisiana State University (May 2015).

37. "Development of an improved model for conductive heat transfer to particle flows," Physics Department, University of Extremadura, Badajoz, Spain (Jul 2015).

38. "Using Fundamentals and Creativity to Tackle Today's Energy Challenges," Department of Mechanical and Process Engineering, ETH Zurich (May 2017).

39. "Modeling Cohesive Particle Flows: Sticky is tricky," Physics Department, University of Extremadura, Badajoz, Spain (Jul 2018).

40. "Efforts toward a predictive understanding of cohesive, granular materials," Physics Department, Montana State University (Apr 2019).

41. "Attractive couples break up unexpectedly," Mechanical Engineering Department, University of Michigan (Apr 2019).

42. "Attractive couples break up unexpectedly," Mechanical Engineering Department, University of Michigan (Oct 2019).

43. "Playing rough: How micro-scale particle properties influence macroscopic transport," Department of Chemical and Process Engineering, University of Surrey (Mar 2020; cancelled due to covid-19 outbreak).

44. "A trifecta of surprising observations in particulate systems," Department of Chemical Engineering, Columbia University, virtual due to covid-19 outbreak (Mar 2021).

45. "Beyond the conventional uses of DEM in solving industrial problems," Department of Chemical and Biochemical Engineering, Rutgers University, virtual (Dec 2022).

***Conferences and Workshops***

46. "Effects of Polydispersity on Granular Shear Flows," Multiphase Fluid Dynamics Research Consortium Meeting, Albuquerque, NM (Apr 2000).

47. "Effects of Polydispersity on Granular Shear Flows," Particles and Beyond: 2000 Workshop, Colorado School of Mines (May 2000).

48. "The Impact of Continuous Size Distributions on Stresses in Granular Shear Flows," Multiphase Fluid Dynamics Research Consortium Meeting, Midland, MI (Oct 2000).

49. "Molecular-Dynamics Simulations of Grains with a Distribution of Sizes," Multiphase Fluid Dynamics Research Consortium Meeting, Morgantown, WV (Apr 2001).

50. "On the Simulation of Flows composed of Inelastic, Cohesive Solids," Multiphase Fluid Dynamics Research Consortium Meeting, Salt Lake City, UT (Aug 2001).

51. "Discrete-Element Modeling (DEM) of Solids Flows," Summer School in Winter, Particle Science & Technology ERC, University of Florida (Jan 2002).

52. "Rapid Granular Flows: A Comparison of DEM and Kinetic-Theory Predictions for Complex Systems," Department of Energy GLUE Workshop, Argonne National Laboratory, Chicago, IL (Mar 2002).

53. "A Critical Assessment of the Equipartition-of-Energy Assumption in Particle Flows," Multiphase Fluid Dynamics Research Consortium Meeting, West Lafayette, IN (Apr 2002).

54. "2D or not 2D: That is the Question," Multiphase Fluid Dynamics Research Consortium Meeting, Baltimore, MD (Sep 2002).

55. "(Not) everything you ever (did not) wanted to know about being a faculty member…," University of Colorado GAANN Retreat, Winter Park, CO (Nov 2002).

56. "Discrete-Element Modeling (DEM) of Solids Flows," Summer School in Winter, Particle Science & Technology ERC, University of Florida (Jan 2003).

57. "Ongoing Research Efforts in Granular Flows and Aerosols," NASA Office of Biological and Physical Research – Workshop on Fine Particulates, NASA Glenn Research Center (May 2003).

58. "Bridging the gap between flows of light and massive particles (from aerosols to grains)," NASA Office of Biological and Physical Research – Workshop on Fine Particulates, NASA Glenn Research Center (May 2003).

59. "Recent findings for particulate flows undergoing species segregation," Multiphase Fluid Dynamics Research Consortium Meeting, Ann Arbor, MI (Jun 2003).

60. "Discrete-Element Modeling (DEM) of Solids Flows," Summer School in Winter, Particle Science & Technology ERC, University of Florida (Jan 2004).

61. "Computational Findings for Polydisperse Granular Flows and their Implications," CECAM Workshop – Experimentalist-Modeling Interactions: New Trends on Modeling Granular Flows, Lyon, France (Jun 2004).

62. "Discrete-Element Modeling (DEM) of Solids Flows," Summer School in Winter, Particle Science & Technology ERC, University of Florida (Jan 2005).

63. "Segregation and Non-equipartition Phenomena in Hard-Sphere Mixtures," Granular Physics Workshop, Kavli Institute for Theoretical Physics, University of California at Santa Barbara (May 2005).

64. "Impact of Non-uniform Size Distribution on Clustering in Rapid Granular Flows," Gordon Conference on Engineering Sciences for Space Exploration, Les Diablerets, Switzerland (Aug 2005).

65. "Assessment of Heat Flux Laws in Thermally-Driven Granular Gases," Southern Workshop on Granular Materials, Vina del Mar, Chile (Sep 2006).

66. "Beyond Navier-Stokes Order Effects in Granular Gases," APS March Meeting, Denver, CO (Mar 2007).

67. "Agglomeration of Wetted Particulates," Granular Flows: A Proving Ground for Nonequilibrium Statistical Mechanics, Sevilla, Spain (Sep 2007).

68. "Agglomeration and De-agglomeration in Wetted, Particulate Systems," Gordon Research Conference on Granular and Granular-fluid Flows, Waterville, Maine (Jun 2008).

69. "On the Description of Granular Flows with a Continuous Size Distribution," Granular Gases 2008, Thorneau, Germany (Sep 2008).

70. "Continuum Theory for Collision-Based, Granular Flows with Continuous Size Distributions," Workshop on Lunar and Martian Plume Effects, Kennedy Space Center, Florida (Oct 2008).

71. "Kinetic Theory of Polydisperse Granular Flows and Validation Data," DOE NETL Workshop on Multiphase Flow Science, Morgantown, WV (Apr 2009).

72. "Solids Processing of Biomass," Colorado Center for Biorefining and Biofuels (C2B2) Short Course, Fort Collins, CO (May 2009).

73. "Molecular Dynamics-Driven Transport Coefficients for Granular Flows: A Perspective," Festschrift Session for Professor Dimitri Gidaspow's 75th Birthday, Annual Meeting of the American Institute of Chemical Engineers, Nashville, TN (Nov 2009).

74. "Enskog-based Hydrodynamic Description of Gas-Solid Suspensions," Southern Workshop on Granular Materials, Vina del Mar, Chile (Dec 2009).

75. "Experiments and Model Development for Polydisperse, Gas-Fluidized Systems," DOE NETL 2010 Workshop on Multiphase Flow Science, Pittsburgh, PA (May 2010).

76. "Role of Collisions in Erosion of Lunar Regolith," Workshop on Lunar and Martian Plume Effects, Kennedy Space Center, FL (Jan 2011).

77. "Segregation in Rapid Flows: Continuum and DEM," Granular Flows Summer School, University of Maryland, MD (Jun 2011).

78. "Dense-Phase Modeling Challenge: Summary of Results and Plan for Documentation," NSF-IFPRI Powder Flow Collaboratory Workshop, Duke University, NC (Jun 2011).

79. "Polydispersity Model Development & Validation: Report on Findings," DOE NETL 2010 Workshop on Multiphase Flow Science, Pittsburgh, PA (Aug 2011).

80. "Experiments in Gas-Solid Fluidized Beds using Continuous Particle Size Distributions," ZCAM Workshop on Granular and Active Fluids, Zaragoza, Spain (Sep 2011).

81. "Recent Progress on the Description of Granular Gases at Moderate Concentrations," 28$^{th}$ International Symposium on Rarefied Gas Dynamics, Zaragoza, Spain (Jul 2012).

82. "Collisions in granular flows: Role in lunar regolith ejection and cohesive effects," Boulder Asteroid Interior Workshop," Boulder, CO (Aug 2012).

83. "Quantitative Predictions of Instabilities in Solid-Particle Flows," Special Session to Celebrate John Chen's Career Long Accomplishments, Annual Meeting of the American Institute of Chemical Engineers, Pittsburgh, PA (Nov 2012).

84. "Using Solid Particles as Heat Transfer Fluid for use in Concentrating Solar Power (CSP) Plants," DOE National Renewable Energy Laboratory SunShot Initiative Kickoff, Golden, CO (Jun 2013).

85. "Dynamics of Wetted-particle Collisions," 2013 Robert Pfeffer Symposium, Annual Meeting of the International Fine Particles Research Institute, Newark, DE (Jun 2013).

86. "Grand Challenges of Dense-Phase Granular Flows," 2$^{nd}$ Institute of Mathematics and its Applications Conference on Dense Granular Flows (invited panel member), Cambridge, UK (Jul 2013).

87. "Validation of Computational Codes," 2013 AIChE Annual Meeting, San Francisco, CA (Nov 2013).

88. "Role of Surface Roughness in Predicting the Micro to Macroscale Behavior of Cohesive Particles," 2014 Gordon Research Conference on Granular and Granular-Fluid Flow (presented by C. Q. LaMarche), Easton, MA (Jul 2014).

89. "Small particles caught between a rough spot and a sticky situation," 2014 AIChE Annual Meeting, Atlanta, GA (Nov 2014).

90. "Pachinko Revisited: Predicting Granular Flows and their Heat Transfer", 2014 AIChE Annual Meeting, Atlanta, GA (Nov 2014).

91. "Validation of a new kinetic theory based two-fluid model for monodisperse gas-solid particulate flows," Japan-U.S. Seminar on Two-Phase Flow Dynamics (presented by W. D. Fullmer), West Lafayette, IN (May 2015).
92. "DEM Validation via System-Size-Independent Measurements," 8th Sino-US Joint Conference of Chemical Engineering, Shanghai, China (Oct 2015).
93. "Breaking Up is Hard To Do: On the De-agglomeration of Cohesive Particles," Frontiers in Particle Science and Technology, Houston, TX (Apr 2016).
94. "Cohesive Granular Matter: Linking Micro-Scale Interactions to Macro-Scale Flow Behavior," Gordon Research Conference on Granular Matter, North Easton, MA (Jul 2016).
95. "Gas-solid clustering: Not your ordinary instability," 2016 AIChE Annual Meeting, San Francisco, CA (Nov 2016).
96. "Cohesive particle flows: On the relevance of cohesive energy vs. cohesive force descriptions," 2016 AIChE Annual Meeting, San Francisco, CA (Nov 2016).
97. "Sticky and Tricky: Cohesive-particle flows," Workshop on Particles & Fluids: from individual particle dynamics to collective effects and fluidized beds, Roscoff, France (Apr 2017).
98. "CFD-DEM: Modeling the small to understand the large," SIAM Conference on Computational Science and Engineering (CSE19), Spokane, WA (Feb 2019).
99. "Aggregation Kernels for Flows of Cohesive Grains," IFSTTAR Workshop on Particle Breakage in Granular Flow, Nantes, France (Mar 2020; workshop cancelled due to covid-19 outbreak).
100. "Cohesive-particle flows: Getting out of a sticky situation," Powder Flow Conference, virtual due to covid-19 outbreak (Mar 2021).
101. "The flow of solids: Piecing together the puzzle", Leeds Fluids Symposium 2021, virtual due to covid-19 outbreak (Jun 2021).
102. "Don't get stuck: A DEM model for particle-particle cohesion using simple bulk experiments," AIChE Annual Meeting, Phoenix, Az (Nov 2022).
103. "Unexpected behaviors in particle systems and what we learn from them," TUSAIL Workshop, Twente University, The Netherlands (Nov 2022).

***Industry and National Laboratories***

104. "Predicting the Hydrodynamic Behavior of Dense-Phase Flows," The Dow Chemical Company, Midland, MI (Oct 1994).
105. "CFD Modeling of Gas-Particle Systems," The Dow Chemical Company, Midland, MI (Jun 1995).
106. "Fundamental Modeling of Gas-Solid Flows," Pittsburgh Energy Technology Center, Department of Energy, Pittsburgh, PA (Sep 1995).
107. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Exxon Chemical Company, Basic Chemicals Division, Baytown, TX (Jan 1998).
108. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Cargill Research, Wayzata, MN (Feb 1998).
109. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Shell Development Co., Fluid Mechanics / Reaction Engineering, Houston, TX (Feb 1998).

110. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows," Exxon Production Research, Reservoir Division, Houston, TX (Feb 1998).
111. "Effects of Scale-Up and Polydispersity in Fluidized Gas-Solid Systems," Millennium Inorganic Chemicals, Research Center, Baltimore, MD (Feb 2000).
112. "Effects of Scale-Up and Polydispersity in Fluidized Gas-Solid Systems," Ames Laboratory, Iowa State University (Mar 2000).
113. "On Two Phenomena of Particulate Flows: Thermophoresis in Aerosols and Polydispersity in Granular Systems," Millennium Inorganic Chemicals, Research Center, Baltimore, MD (Mar 2001).
114. "On the Simulation of Flows composed of Inelastic, Cohesive Solids," Ames Laboratory, Iowa State University, IA (Jun 2001).
115. "Clustering in Dense Gas-Solid Flows," NASA Glenn Research Center, Cleveland, OH (Aug 2001).
116. "Rheology of Rapid Flows with Multi-sized or Cohesive Grains," NASA Glenn Research Center, Cleveland, OH (Aug 2001).
117. "MFIX Simulations of Fluidized Beds with Polydisperse or Cohesive Materials," Department of Energy NETL, Morgantown, WV (Mar 2004).
118. "Overview of Kinetic Theory Analogy for Solids Flows," Arena-flow, Albuquerque, NM (Jan 2005).
119. "Development, Verification, and Validation of Multiphase Models for Polydisperse Flows," Department of Energy NETL, Morgantown, WV (May 2007).
120. "Kinetic Theory of Polydisperse, Granular Flow and Validation Experiments," Department of Energy NETL, Morgantown, WV (Apr 2008).
121. "Benefits and Shortfalls of Modeling Tools for Solids Flows," UOP / Honeywell Invitational Lecture Series, Chicago, IL (May 2009).
122. "Agglomeration and De-agglomeration of Wetted Particles: Stokes's Cradle and Beyond," Bristol-Myers Squibb, New Brusnwick, NJ (Sep 2010).
123. "An Overview of Modeling Activities for Solids Flows," Hemlock Semiconductor Corporation, Midland, MI (Mar 2011).
124. "Using Solid Particles as Heat Transfer Fluid for use in Concentrating Solar Power (CSP) Plants", Department of Energy, Washington D.C. (Apr 2014).
125. "Quantifying the Uncertainty of Kinetic-theory Predictions of Clustering," 2014 NETL Crosscutting Research Review Meeting (presented by P. P. Mitrano), Pittsburgh, PA (May 2014).
126. "Pachinko Revisited: Predicting Gas-Solid Flows and their Heat Transfer," Department of Energy, NETL, Morgantown, WV (Jan 2015).
127. "Cohesive Particle Fluidization," Dow Corning, Midland, MI (Jan 2015).
128. "Development of Gas-solid Heat Transfer Model for use in Concentrating Solar Power (CSP) Plants", Department of Energy, Washington D.C. (Mar 2015).
129. "MFIX-DEM Enhancement for Industry-Relevant Flows," 2019 Annual Project Review Meeting for Crosscutting Research, Rare Earth Elements, Gasification Systems, and Transformative Power Generation, Pittsburgh PA (Apr 2019).

130. "MFIX-DEM Enhancement for Industry-Relevant Flows," 2021 DOE/FE Spring R&D Project Review; virtual due to covid-19 outbreak (presented by W. C. Q. LaMarche; May 2021).

***Miscellaneous***

131. "Reflections on being a (female) professor in STEM," Society of Women Engineers, Peak to Peak Charter School, Lafayette, CO; virtual due to covid-19 outbreak (Apr 2021).

132. "Glass half full: Embracing the unexpected in granular systems," *Granular Matter* webinar (Oct 2020).

133. "(Not) everything you ever (did not) wanted to know about being a faculty member…," University of Colorado GAANN Retreat, Winter Park, CO (Nov 2002)

134. "Chemical Engineering as a Career," Strongsville High School, Strongsville, OH (Jan 1995).

## PATENTS

1. J. Grace, A. H. Ahmadi-Motlagh, M. Salcudean and C. Hrenya, "Methods and Systems for Simulation Hydrodynamics in Gas-solid Fluidized Beds," U.S. Patent No. 10,423,736, issued 24 Sep 2019 to University of British Columbia.

## RESEARCH PERSONNEL DIRECTED

***Graduate Students***

| | | |
|---|---|---|
| Steven Dahl | Ph.D. Chemical Engineering (2004) | University of Colorado |
| Mike Weber | Ph.D. Chemical Engineering (2004) | ExxonMobil |
| Casey Carney | Ph.D. Chemical Engineering (2005) | Department of Energy (staff scientist) |
| Jennifer Walsh | Ph.D. Chemical Engineering (2005) | CoorsTek |
| Advait Kantak | Ph.D. Chemical Engineering (2005) | Intel |
| Janine Galvin[*] | Ph.D. Chemical Engineering (2007) | Department of Energy (staff scientist) |
| José Leboreiro | Ph.D. Chemical Engineering (2007) | Archer Daniels Midland |
| Brent Rice | Ph.D. Chemical Engineering (2009) | Cardian BCT |
| Jia-Wei Chew[**] | Ph.D. Chemical Engineering (2011) | Nanyang Tech. Univ. (Assoc. Prof.) |
| Carly Donahue | Ph.D. Physics (2011) | Los Alamos National Laboratory |
| Aaron Murray | M.S. Chemical Engineering (2012) | U.S. Environmental Protection Agency |
| Peter Mitrano | Ph.D. Chemical Engineering (2014) | Colorado Mesa University (Instructor) |
| Kyle Berger | Ph.D. Chemical Engineering (2016) | Practical Scientific Solutions |
| Aaron Lattanzi | Ph.D. Chemical Engineering (2018) | Lawrence Berkeley National Lab. |
| Kevin Kellogg | Ph.D. Chemical Engineering (2018) | Dow |
| Ipsita Mishra | Ph.D. Chemical Engineering (2021) | Corteva Agriscience |

[*]*Recipient of 2008 AIChE Best Ph.D. in Particle Technology Award*
[**]*Recipient of 2013 AIChE Best Ph.D. in Particle Technology Award*

***Postdoctoral Researchers***

| | | |
|---|---|---|
| Meheboob Alam | 1999-2000 | Jawaharlal Nehru Center, India (Professor) |
| Gustavo Joseph | 2004-2007 | Maxim Integrated |
| Harish Viswanathan | 2007-2008 | Comsol Multiphysics |
| Anshu Anand | 2009-2011 | Tridiagonal Solutions |
| Aaron Morris | 2013-2015 | Purdue University (Assistant Professor) |
| Peter Mitrano | 2014 | Colorado Mesa University (Instructor) |

| | | |
|---|---|---|
| Casey LaMarche | 2013-2017 | Particulate Solid Research Inc. |
| William Fullmer*** | 2014-2017 | Department of Energy |
| Peiyuan Liu | 2013-2019 | Pfizer |

****Recipient of 2018 American Institute of Chemists Postdoc Award*

***Senior Research Associates***

| | |
|---|---|
| Steven Dahl | 2010-2011 |
| | 2017-2021 |

***Undergraduate Students***

| | | | |
|---|---|---|---|
| Michael Detamore | 1998-1999 | Kim Frender | 1998-1999 |
| Manuel Najar | 1999 | Michael Swanson | 1999-2000 |
| David Michaels | 2000-2001 | Matthew Condiotti | 2000-2001 |
| Melinda Roskos | 2001-2001 | Samaria Moore | 2002 |
| Houston Frost | 2002 | Laura Crawford | 2003 |
| Drew Stevens | 2003-2004 | Joseph Duncan | 2004 |
| John Bedenbaugh | 2005 | Matt Lehr | 2005 |
| Heather Woods | 2005-2006 | Andrea Stevens | 206 |
| Elsa Birch | 2006 | Dorota Gawel | 2006 |
| Joe Kozlowski | 2006-2007 | Jonathan Tebbe | 2007 |
| Kenshiro Nakagawa | 2007-2008 | Alexandra Zelinskaya | 2007-2008 |
| Katherin Potter | 2008-2009 | Zach Greene | 2009 |
| Michael Pacella | 2009 | Jeff Wolz | 2008-2009 |
| Daniel Cromer | 2008-2010 | Drew Parker | 2010 |
| Will Brewer | 2010-2011 | Andrew Hilger | 2011 |
| John Zenk | 2011-2012 | Chris Ewasko | 2011-2012 |
| Brendan Brown | 2012-2013 | Connor Slagle | 2013 |
| Danh Nguyen | 2013 | Lukas Johnson | 2013-2014 |
| Tony Neumayer | 2012-2014 | Andrew Miller | 2013-2015 |
| Nicholas Bongiardina | 2013-2014 | Christopher Huth | 2013-2015 |
| Bernard Britt | 2013-2014 | Benjamin Grote | 2014-2016 |
| Jonathan Fearer | 2014 | Christopher Moody | 2014 |
| Lucas Nobre | 2014 | Kacey Paulin | 2014-2015 |
| Alexi Ortega | 2015-2016 | Jack Huettel | 2015 |
| Haley Manchester | 2015-2017 | Connor Gerace | 2016 |
| Lucas Karasek | 2016-2017 | Elijah Holland | 2016 |
| Harrison Stout | 2017 | Maia Lentz | 2017 |
| Marisa Olivia Pacheco | 2018 | Raka Ghosh-Dastidar | 2017-present |
| Chloe Bruce | 2017-present | | |

## COURSES TAUGHT

Applied Data Analysis, CHEN 3010 (undergraduate course)

| | | |
|---|---|---|
| Fall 2010 | 111 students | Instructor Rating – 4.4 / 6.0 |

Chemical Engineering Fluid Mechanics, CHEN 3200 (undergraduate course)

| | | |
|---|---|---|
| Spring 2015 | 92 students | Instructor Rating – 5.2 / 6.0 |
| Spring 2013 | 55 students | Instructor Rating – 5.7 / 6.0 |
| Spring 2012 | 87 students | Instructor Rating – 5.3 / 6.0 |

| | | |
|---|---|---|
| Spring 2010 | 97 students | Instructor Rating – 5.3 / 6.0 |
| Spring 2008 | 54 students | Instructor Rating – 5.8 / 6.0 |
| Spring 2005 | 57 students | Instructor Rating – 5.0 / 6.0 |
| Spring 2004 | 55 students | Instructor Rating – 3.3 / 6.0 |
| Spring 2002 | 51 students | Instructor Rating – 5.4 / 6.0 |

Instrumentation and Process Control, CHEN 4570 (undergraduate course with laboratory section)

| | | |
|---|---|---|
| Spring 2017 (Sec 1) | 87 students | Instructor Rating – 5.3 / 6.0 |
| Spring 2017 (Sec 2) | 84 students | Instructor Rating – 4.9 / 6.0 |
| Spring 2016 | 70 students | Instructor Rating – 5.3 / 6.0 |
| Spring 2007 | 46 students | Instructor Rating – 5.7 / 6.0 |
| Spring 2003 | 35 students | Instructor Rating – 4.5 / 6.0 |
| Spring 2000 | 54 students | Instructor Rating – 4.0 / 6.0 |
| Spring 1999 | 44 students | Instructor Rating – 5.6 / 6.0 |

Particle Technology, CHEN 4650/5650 (combined undergraduate/graduate course)

| | | |
|---|---|---|
| Fall 2018 | 35 students | Instructor Rating – 4.9 / 6.0 |
| Spring 2017 | 39 students | Instructor Rating – 5.1 / 6.0 |
| Fall 2014 | 46 students | Instructor Rating – 4.4 / 6.0 |
| Spring 2011 | 27 students | Instructor Rating – 5.7 / 6.0 |
| Fall 2008 | 41 students | Instructor Rating – 4.8 / 6.0 |
| Fall 2006 | 25 students | Instructor Rating – 4.7 / 6.0 |
| Fall 2004 | 22 students | Instructor Rating – 5.4 / 6.0 |
| Fall 2002 | 22 students | Instructor Rating – 4.8 / 6.0 |

Mathematical Methods Short Course for Chemical Engineering, CHEN 5730 (graduate course)

| | |
|---|---|
| Fall 2017 | 22 students |

Mathematical Methods in Chemical Engineering, CHEN 5740 (graduate course)

| | | |
|---|---|---|
| Fall 2015 | 33 students | Instructor Rating – 5.1 / 6.0 |
| Fall 2012 | 19 students | Instructor Rating – 5.1 / 6.0 |
| Fall 2011 | 21 students | Instructor Rating – 4.8 / 6.0 |
| Fall 2009 | 47 students | Instructor Rating – 5.4 / 6.0 |
| Fall 2003 | 33 students | Instructor Rating – 4.6 / 6.0 |
| Spring 2001 | 12 students | Instructor Rating – 5.2 / 6.0 |
| Fall 1999 | 19 students | Instructor Rating – 5.4 / 6.0 |
| Fall 1998 | 14 students | Instructor Rating – 4.8 / 6.0 |

Oral Communication of Science, CHEN 5838 (graduate course)

| | | |
|---|---|---|
| Summer 2020 | 13 students | Composite Rating – 4.6 / 5.0** |

**new questionnaire with 5.0 scale and with averaged rating of all questions reported

## CONFERENCE ORGANIZATING COMMITTEES

| | |
|---|---|
| Vice Chair (elected) | 2004 Gordon Research Conference on Granular and Granular-Fluid Flows (Colby College, ME) |
| Social Functions Director | 2006 World Congress of Particle Technology V (Orlando, FL) |
| Organizing Committee | 2008 Institute of Mathematics and its Applications: Workshop on Dense Granular Flows (Cambridge, UK) |
| Organizing Committee | 2009 Powders and Grains (Golden, CO) |
| Organizing Committee | 2011 International Conference on Fluidized Bed Technology - CFB-10 (Bend, OR) |

| | |
|---|---|
| Organizing, Fundraising | 2013 Institute of Mathematics and its Applications: Second Workshop on Dense Granular Flows (Cambridge, UK) |
| Organizing Committee | 2013 Fluidization XIV, Noordwijkerhout, The Netherlands |
| Organizing, Fundraising | 2014 AIChE PTF Frontiers in Particle Science and Technology: Particle Interactions Applied |
| Organizing Committee | 2018 Enabling Process Innovation through Computation Workshop – EPIC II (Banff, Canada) |
| Organizing Committee | 2019 Institute of Mathematics and its Applications: Third Workshop on Dense Granular Flows (Cambridge, UK) |