Georgios (George) M. Bollas

Assistant Professor, Chemical Engineer, PhD
Department of Chemical & Biomolecular Engineering, University of Connecticut
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Summary

Dr. George Bollas is a process design expert and winner of the prestigious NSF CAREER and ACS PRF DNI Awards. He is the director of the Process Design Simulation and Optimization Laboratory (PDSOL), which performs research on system intensification and processes that address the growing energy crisis and the environmental impact of energy production. His current research portfolio includes model-based and experimental analyses of processes for chemical-looping combustion with an emphasis on the scale-up of existing pilot plants to power plant capacities; experimental and theoretical studies of biomass pyrolysis, gasification, and catalyst deactivation during biomass catalytic processing; Fischer-Tropsch Synthesis; and model-based fault diagnostics identification and avoidance of thermal fluid systems.

Highlights

- **Scholarly Achievements**
  - 1 Patent Application
  - 26 Peer reviewed archival publications
  - 2 Book Chapters, 80+ Conference proceedings and presentations
- **Research Funding**
  - Total funding value of over $3M in 11 Funded Grants
- **Honors and Awards**
  - National Science Foundation (NSF), CAREER Award, 2011.
  - American Chemical Society (ACS), Petroleum Research Fund (PRF), Doctoral New Investigator (DNI) Award, 2013.
  - Elected Chair for the Applied Chemical Technology Subdivision (ACTS) of the American Chemical Society (ACS) for 2011.
  - UConn Provost's Award for Excellence in Teaching, 2014-2015
  - UConn Mentorship Excellence Award, in recognition of outstanding mentorship of undergraduate researchers, 2015
- **Student Advising**
  - 2 Postdoctoral Research Associates
  - 13 Graduate Students
  - 20+ Undergraduate researchers
- **Teaching**
  - Dedicated Educator with highest marks from students
  - 5/5 Teaching Evaluations for all courses at UConn in 2014
  - Course coordinator and instructor of the Controlled Systems track of the curriculum of the Institute for Advanced Systems Engineering of United Technologies Corporation.

Education and Training:

Institution	Major	Degree	Year
Aristotle University of Thessaloniki	Chemical Engineering	B.S.	2000
Aristotle University of Thessaloniki	Chemical Engineering	Ph.D.	2006
Massachusetts Institute of Technology	Chemical Engineering	Postdoc	2006-2009

Graduate Advisors:

- *Postdoctoral:* Paul I. Barton, Massachusetts Institute of Technology
- *Doctoral:* Iacovos Vasalos, Aristotle University of Thessaloniki

Research and Professional Experience:

2010 – Present: Assistant Professor, University of Connecticut, Storrs, CT, USA
2009 – 2009: Research Associate, Rive Technology Inc., Cambridge, MA, USA
2006 – 2009: Postdoctoral Research Associate, Massachusetts Institute of Technology, Department of Chemical Engineering, Cambridge MA, USA
2004 – 2006: Cooperative Research Member, Automation Department, Alexander Technological Educational Institute of Thessaloniki, Thessaloniki, Greece
2001 – 2006: Doctoral Research Assistant, CPERI, Thessaloniki, Greece

Honors and Awards

- National Science Foundation (NSF), CAREER Award, 2011.
- American Chemical Society (ACS), Petroleum Research Fund (PRF), Doctoral New Investigator (DNI) Award, 2013.
- Elected Chair for the Applied Chemical Technology Subdivision (ACTS) of the American Chemical Society (ACS) for 2011.
- UConn Provost's Award for Excellence in Teaching, 2014-2015
- UConn Mentorship Excellence Award, in recognition of outstanding mentorship of undergraduate researchers, 2015

Thesis and Research Advisees:

- *Postdoctoral Research Associates:*
  - M. Navarro (Feb 2013, now Biometrics Engineer at Spiraledge, Inc.)
  - M. Fernanda Carulo (Sep 2014)
- *PhD Students:*
  - Z. Zhou (Jan 2015, now R&D Engineer with Alstom Power Inc.)
  - S. Du (Graduation Date: May 2015)
  - L. Han (Graduation Date: Sep 2015)
  - C. Zhu (Graduation Date: Jan 2018)
  - K. Palmer (Graduation Date: Jan 2019)
  - B. Bailee (Graduation Date: May 2019)
  - W. Hale (Graduation Date: Sep 2019)
  - C. Chen (Graduation Date: Sep 2019)
- *Masters Students:*
  - F. Poretti (Jan 2013, now with Polytechnic Institute of Milano)

- J. DesJardins (Jan 2014, now Oil & Energy Professional)
- X. Yan (Graduation Date: Sep 2016)

- *Undergraduate Researchers:*
  S. Pradhan, P. Lins Barros, A. Paluch, K. Gain, K. Such, A. Williams, A. Fischer, O. Nordness, A. Nguyen, C. Cheu, Y. Sun, C. Palmer, C. Collins, B. Ciezynski, N. Fleming, M. Fedge, T. Omasta, C. Unger, S. Reid, K. Ivey and S. Quinn (UConn), J. Lansford (U. Virginia), P. Smadbeck, E. Choi and K. Schumacher (with P.I. Barton, MIT).

Patent Applications:

1. **Bollas GM**, Han L., Baillie B. Reactor for Chemical-Looping Combustion. US Patent Application- University of Connecticut. 2015

Peer-Reviewed Publications (in reverse chronological order):

University of Connecticut

1. Zhou Z, Han L, Nordness O, **Bollas GM**. Continuous regime of chemical looping combustion (CLC) and chemical-looping with oxygen uncoupling (CLOU) reactivity of CuO oxygen carriers. *Appl. Catal. B Environ.* 2015;166-167:132-44.
2. Fischer A, Du S, Valla JA, **Bollas GM**. The effect of temperature, heating rate, and ZSM-5 catalyst on the product selectivity of the fast pyrolysis of Spent Coffee Grounds, *RSC Adv.* 2015; 5, 29252–61.
3. Du S, Sun Y, Gamliel DP, Valla JA, **Bollas GM**. Catalytic pyrolysis of miscanthus × giganteus in a spouted bed reactor. *Bioresour Technol.* 2014;169:188-97
4. Zhou Z, Han L, **Bollas GM**. Kinetics of NiO reduction by H_2 and Ni oxidation at conditions relevant to chemical-looping combustion and reforming. *Int J Hydrogen Energy.* 2014;39: 8535-56.
5. Han L, Zhou Z, **Bollas GM**. Heterogeneous Modeling of Chemical-Looping Combustion. Part 2: Particle Model. *Chem Eng Sci.* 2014;113:116-28
6. Zhou Z, Han L, **Bollas GM**. Overview of Chemical-Looping Reduction in Fixed Bed and Fluidized Bed Reactors Focused on Oxygen Carrier Utilization and Reactor Efficiency. *Aerosol Air Qual Res.* 2014;14:559-71
7. Noshadi I, Kanjilal B, Du S, **Bollas GM**, Suib SL, Provatas A, Liu F, Parnas RS. Catalyzed production of biodiesel and bio-chemicals from brown grease using Ionic Liquid functionalized ordered mesoporous polymer. *Appl Energy.* 2014;129:112-22
8. Zhou Z, Han L, **Bollas GM**. Model-based Analysis of Bench-Scale Fixed-Bed Units for Chemical-Looping Combustion. *Chem Eng J.* 2013;233:331-48
9. Han L, Zhou Z, **Bollas GM**. Heterogeneous Modeling of Chemical-Looping Combustion. Part 1: Reactor Model. *Chem Eng Sci.* 2013;18:233-49
10. Du S, Valla JA, **Bollas GM**. Characteristics and Origin of Char and Coke from Fast and Slow, Catalytic and Thermal Pyrolysis of Biomass and Relevant Model Compounds. *Green Chem.* 2013;15(11):3214-29

Manuscripts in Review

11. Nordness O, Zhou Z, **Bollas GM**. High-pressure chemical-looping of synthesis gas with Ni and Cu oxygen carriers, *Energy & Fuels.* 2015; in review.

12. Du S, Gamliel DP, Giotto MV, Valla JA, **Bollas GM**. Coke formation mechanisms of model compounds relevant to pyrolysis bio-oil over ZSM-5 zeolites and supported catalysts. *J. Catal.* 2015; in review
13. Han L, Zhou Z, **Bollas GM**. Model-based Analysis of Chemical-Looping Combustion Experiments. Part II: Results and Interpretation of CH_4-NiO Reduction Experiments. *Chem. Eng. J.* 2015; in review.
14. Han L, Zhou Z, **Bollas GM**. Model-based Analysis of Chemical-Looping Combustion Experiments. Part I: Problem Statement and Mathematical Framework. *Chem. Eng. J.* 2015; in review.
15. Han L, Zhou Z, **Bollas GM**. Chemical-looping combustion in a reverse-flow fixed-bed reactor. *Environ. Sci. Technol.* 2015; in review.
16. Zhou Z, Han L, **Bollas GM**. Modeling chemical-looping combustion in bubbling fluidized bed reactors. *Chem. Eng. Sci.* 2015; in review.

Massachusetts Institute of Technology

17. **Bollas GM**, Barton PI, Mitsos A. Bilevel optimization formulation for parameter estimation in vapor-liquid(-liquid) phase equilibrium problems. *Chem. Eng. Sci.* 2009;64:1768-1783.
18. Mitsos A, **Bollas GM**, Barton PI. Bilevel optimization formulation for parameter estimation in liquid–liquid phase equilibrium problems. *Chem. Eng. Sci.* 2009;64(3):548-559.
19. **Bollas GM**, Chen CC, Barton PI. Refined Electrolyte-NRTL Model : Activity Coefficient Expressions for Application to Multi-Electrolyte Systems. *AIChE J.* 2008;54(6):1608-1624.

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20. **Bollas GM**, Lappas AA, Iatridis DK, Vasalos IA. Five-lump kinetic model with selective catalyst deactivation for the prediction of the product selectivity in the fluid catalytic cracking process. *Catal. Today* 2007;127(1-4):31-43.
21. **Bollas GM**, Vasalos IA, Lappas AA, Iatridis DK, Voutetakis SS, Papadopoulou SA. Integrated FCC riser-regenerator dynamics studied in a fluid catalytic cracking pilot plant. *Chem. Eng. Sci.* 2007;62(7):1887-1904.
22. **Bollas GM**, Anastasiou I, Papadopoulou S a., Voutetakis SS, Seferlis P. Feed conversion targeting in an FCC pilot plant using a non-linear MPC strategy. *2007 Am. Control Conf.* 2007:632-638.
23. **Bollas GM**, Vasalos IA, Lappas AA, Iatridis DK, Tsioni GK. Bulk Molecular Characterization Approach for the Simulation of FCC Feedstocks. *Ind. Eng. Chem. Res.* 2004;43(13):3270-3281.
24. **Bollas GM**, Papadokonstantakis S, Michalopoulos J, et al. A Computer-Aided Tool for the Simulation and Optimization of the Combined HDS–FCC Processes. *Chem. Eng. Res. Des.* 2004;82(7):881-894.
25. **Bollas GM**, Papadokonstadakis S, Michalopoulos J, et al. Using hybrid neural networks in scaling up an FCC model from a pilot plant to an industrial unit. *Chem. Eng. Process.* 2003;42(8-9):697-713.
26. **Bollas GM**, Vasalos IA, Lappas AA, Iatridis DK. Modeling Small-Diameter FCC Riser Reactors. A Hydrodynamic and Kinetic Approach. *Ind. Eng. Chem. Res.* 2002;41(22):5410-5419.

Book Chapters:

Massachusetts Institute of Technology

1. Mitsos A, **Bollas GM**, Barton PI, Model and Parameter Identification in Phase Equilibria, in *Computer Aided Chemical Engineering*, Vol 26, 2009, 597-601

Aristotle University of Thessaloniki

2. **Bollas GM**, Anastasiou I, Papadopoulou SA, Voutetakis SS, Seferlis P, Feed conversion targeting in an FCC pilot plant using a non-linear MPC strategy, in *Proceedings of the American Control Conference*, 2007 , 632-638

Conference Proceedings and Presentations (in reverse chronological order):

University of Connecticut

2014

1. Han L, Zhou Z, **Bollas GM**. Design and Performance of a Novel Reverse-Flow Fixed-Bed Reactor for Chemical-Looping Combustion. In: *AIChE Annual Meeting*. Atlanta, GA, USA; 2014.
2. Han L, Zhou Z, **Bollas GM**. Model-Based Design of Experiments to Achieve Kinetic Validation for Chemical-Looping Systems, Best Presentation Award of the Modeling and Analysis of Chemical Reactors Session. In: *AIChE Annual Meeting*. Atlanta, GA, USA; 2014.
3. Fischer A, Du S, **Bollas GM**. Conversion of Caffeine, Lipids, and Fatty Acids in Catalytic Fast-Pyrolysis of Spent Coffee Grounds. In: *AIChE Annual Meeting*. Atlanta, GA, USA; 2014.
4. Nordness O, Zhou Z, **Bollas GM**. Feasibility of Integration of Chemical Looping Combustion (CLC) in IGCC Systems: High Pressure CLC Experiments with CH_4 and Syngas. In: *AIChE Annual Meeting*. Atlanta, GA, USA; 2014.
5. Du S, Gamliel DP, Valla J, **Bollas GM**. Catalytic Pyrolysis of Char and Coke Precursors: An Investigation of the Formation Mechanisms of Char and Coke. In: *AIChE Annual Meeting*. Atlanta, GA, USA; 2014.
6. Gamliel DP, Du S, **Bollas GM**, Valla J. A Fundamental Study of the Reaction and Diffusion of Poly-Aromatic Hydrocarbons in Hierarchical Pore Structure Zeolites. In: *AIChE Annual Meeting*. Atlanta, GA, USA; 2014.
7. Zhou Z, Nordness O, Han L, **Bollas GM**. Continuous Regime of CLC/CLOU Reactivity and Its Impact on the Dynamic and Steady State Performance of Cu_xO_y Oxygen Carriers. In: *AIChE Annual Meeting*. Atlanta, GA, USA; 2014.
8. Fischer A, **Bollas GM**. Thermochemical CO_2 and H_2O Splitting via Chemical-Looping with Cerium and Cobalt Mixed Oxides to Generate Oxygen for Manned Space Missions. In *2014 AIChE Annual Meeting*; Atlanta, GA, USA; 2014.
9. Nordness O, Zhou Z, **Bollas GM**. Incorporation of High Pressure CLC into IGCC Systems for Carbon Capture. In: *2014 AIChE Annual Meeting*; Atlanta, GA, USA; 2014.
10. Palmer C, Han L, **Bollas GM**. Reactor Design and Analysis of a Simulated Moving Bed Reactor for Chemical-Looping Combustion. In: *2014 AIChE Annual Meeting*; Atlanta, GA, USA; 2014.
11. Han L, Zhou Z, **Bollas GM**. Novel reactor concepts for chemical-looping combustion, In: *3rd International Conference on Chemical Looping Combustion*, Chalmers University, Gothenburg, Sweden, 2014.

12. Gamliel D, Dahl M, Du S, **Bollas GM**. Valla, IA Catalytic reaction of aromatic hydrocarbons using hierarchical pore structure zeolites. In: *Abstract of Papers of the American Chemical Society*, 2014.
13. **Bollas GM**. Parameter identifiability and optimal experimental design: Theory and application on the identification of reaction kinetics in chemical-looping combustion. Invited Seminar, Lunds University, Lunds Sweden, Sep 2014.
14. **Bollas GM**. Model-based exploration novel chemical-looping systems, UTC-IASE Distinguished Lecture Series, Storrs, CT, Apr 2014.
15. **Bollas GM**, Pyrolysis of biomass and renewable feedstocks in the Center for Clean Energy Engineering of the University of Connecticut, at Tokyo University of Science, Jun 2014.

2013

16. Han L. Zhou Z, **Bollas, GM**. Optimal Experiments of Chemical-Looping Combustion in Fixed and Fluidized Beds, Invited Lecture Sponsored by the NSF. In: *9th World Congress of Chemical Engineering*, 2013, Seoul, South Korea.
17. Han L. Zhou Z, **Bollas GM**. Optimal experimental design of fixed-bed chemical-looping combustion systems, In: *Abstracts Of Papers Of The American Chemical Society*, 2013.
18. Han L, Zhou Z, **Bollas GM**. Implementation of Optimal Experimental Design in chemical-looping experimentation. In: *AIChE Annual Meeting*, San Francisco CA, 2013.
19. Han L, Zhou Z, **Bollas GM**. Effect of pore and particle size of oxygen carriers on chemical-looping combustion and reforming. In: *AIChE Annual Meeting*, San Francisco CA, 2013.
20. Zhou Z, **Bollas GM**. Model-assisted comparison of chemical-looping combustion in fixed and fluidized bed reducers, Invited Lecture, In: *Abstracts Of Papers Of The American Chemical Society*, 2013.
21. Zhou Z, Nordness O, **Bollas GM**. On the Kinetics of Ni-Based Oxygen Carrier Reduction and Oxidation Studied in Thermogravimetric Analysis and Fixed-Bed Reactors. In: *AIChE Annual Meeting*; San Francisco, CA, USA; 2013.
22. Zhou Z, Han L, Fischer A, **Bollas GM**. An Overview of Chemical-Looping Reduction in Fixed-Bed and Fluidized Bed Reactors Focused On Oxygen Carrier Utilization and Reactor Efficiency. In: *AIChE Annual Meeting*; San Francisco, CA, USA; 2013.
23. Zhou Z, Nordness O, **Bollas GM**. Comparison of Cu-, Fe- and Ni- Based Oxygen Carriers for Chemical-Looping Combustion. In: *AIChE Annual Meeting*; San Francisco, CA, USA; 2013.
24. Zhou Z, Du S, Fischer A, Han L, **Bollas GM**. Chemical-Looping with Oxygen Uncoupling of Coal in a Spouted Bed. In: *AIChE Annual Meeting*, San Francisco CA, 2013.
25. Nordness O, Zhou Z, **Bollas GM**. Reactivity Analysis of Ni, Cu, Fe Oxygen Carriers in Chemical Looping Combustion. In: *AIChE Annual Meeting*; San Francisco, CA, USA; 2013.
26. Fischer A, **Bollas GM**. Chemicals and Commodities from Waste Coffee: Analysis of Fast Pyrolysis Product with Respect to Experimental Design. In: *2013 AIChE Annual Meeting*; San Francisco, CA, USA; 2013.
27. Du S, Valla IA, **Bollas GM**. Fate of catalyst during catalytic pyrolysis of biomass and relevant model compounds**,** ACS On Demand Invited Lecture Series, In: *Abstracts Of Papers Of The American Chemical Society*, 2013.

28. Du S, Fischer A, **Bollas GM**. Effect of CH_4 Co-Feeding On Biomass Catalytic Pyrolysis. In *2013 AIChE Annual Meeting*; San Francisco, CA, USA; 2013.
29. Du S, Fleming N, Valla JA, **Bollas GM**. Fast Catalytic Pyrolysis of Biomass and Relevant Model Compounds Studied in a Spouted Bed Reactor: Effect of Catalyst Type and Loading. In: *2013 AIChE Annual Meeting*; San Francisco, CA, USA; 2013.
30. Du S, **Bollas GM**. Challenges in the Operation of a Fluidized Bed Reactor for Biomass Pyrolysis. In: *AIChE Annual Meeting*, San Francisco CA, 2013.
31. Du S, **Bollas GM**. Similarities and differences between pyrolysis and gasification of biomass and bio-solids from brown grease. Invited Lecture, 18th Environmental Issues Conference, New York, NY, USA, 2013.
32. Valla IA, Du S, **Bollas GM**. Simulation of coal and biomass to liquids process with parallel power generation based on combined cycle and in-series fuel cell + combined cycle system, In: *Abstracts Of Papers Of The American Chemical Society*, 2013.
33. Akkalkotkar A, **Bollas GM**, Valla I A. Catalytic cracking of tars using hierarchical pore structure zeolites. In: *Abstracts Of Papers Of The American Chemical Society*, 2013.
34. Desjardins J, Collins C, **Bollas GM**. Novel Schemes for CO2 Utilization Using Methane Bi-Reforming and Carbon Formation Reactions. In: *AIChE Annual Meeting*, San Francisco CA, 2013.

2012

35. Valla IA, Du S, **Bollas GM**. Gasification of waste biomass for clean energy production. In: *Abstracts Of Papers Of The American Chemical Society*, 2012.
36. Valla IA, Du S, **Bollas GM**. Clean fuels from biomass: comparison of biofuels produced via catalytic pyrolysis and gasification/Fischer-Tropsch synthesis. Invited Lecture, In: *Abstracts Of Papers Of The American Chemical Society*, 2012.
37. Valla IA, Du S**, Bollas, GM**. Coal and biomass to liquids and power generation via Fischer-Tropsch synthesis and fuel cells, In: *AIChE Annual Meeting*, Pittsburgh PA, 2012.
38. Zhou Z, **Bollas GM**. Kinetics schemes for chemical-looping combustion of methane. In: *Abstracts Of Papers Of The American Chemical Society*, 2012.
39. Zhou Z, **Bollas GM**. Holistic kinetic study of the reduction of CH4 with NiO in chemical-looping combustion, In: *AIChE Annual Meeting*, Pittsburgh PA, 2012.
40. Zhou Z, Navarro M, **Bollas GM**. Modeling chemical-looping combustion in bubbling fluidized bed reactors, In: *AIChE Annual Meeting*, Pittsburgh PA, 2012
41. Navarro M, Orlicki D, **Bollas GM**. Detailed modeling of FCC selectivity in catalyst evaluation experiments. In: *Abstracts Of Papers Of The American Chemical Society*, 2012.
42. Unger C, Valdes H, **Bollas GM**. Processing of Waste CO_2 to Solid Carbon and Liquid Fuels. In: *ACS-CVS Undergraduate Research Symposium*. Springfield, MA, USA; 2012.
43. Lansford J, Orlicki D, **Bollas GM**. Separation of Catalyst Kinetics for Maximizing Gasoline Output, Yield, and Selectivity: A Computational Solution to Catalytic Cracking. In: *AIChE Annual Meeting*; Pittsburgh, PA, USA; 2012.
44. Fischer A, Zhou Z, Han L, **Bollas GM**. Experimental Results and Design of Chemical-Looping Combustion of Methane in a Fixed Bed Reactor with Nickel Based Oxygen Carrier. In: *AIChE Annual Meeting*; Pittsburgh, PA, USA; 2012.

45. Fischer A, Zhou Z, Han L, **Bollas GM**. Chemical-Looping Combustion in High-Pressure Fixed Bed Reactors. In: *ACS-CVS Undergraduate Research Symposium*. Springfield, MA, USA; 2012.
46. Edward A, Poretti F, Richardson J, Willbanks N, Valla JA, **Bollas GM**. IGCC and IGFC processes for clean power generation. In: *ACS-CVS Undergraduate Research Symposium*. Springfield, MA, USA; 2012.
47. Patel T, Oliveria C*, Catania R*, **Bollas GM**, Burkey D. In-situ Resource Generation on Mars. In: *ACS-CVS Undergraduate Research Symposium*. Springfield, MA, USA; 2012.
48. Du S, Poretti F, Noshadi I., Parnas R., **Bollas GM**. 100% conversion of waste brown grease to biodiesel and syngas as valuable products for heat and power cogeneration, In: *AIChE Annual Meeting*, Pittsburgh PA. 2012.
49. Du S, **Bollas GM**. Char and coke characterization from fast and slow, catalytic and non-catalytic pyrolysis of biomass and relevant model compounds, In: *AIChE Annual Meeting*, Pittsburgh PA, 2012.
50. Han L, Fischer A, **Bollas GM**. Optimal experimental design of chemical-looping combustion of syngas in fixed bed reactors, In: *AIChE Annual Meeting*, Pittsburgh PA, 2012.
51. Han L, Zhou Z, **Bollas, GM**. Dynamic 2D heterogeneous model for chemical- looping combustion in fixed bed reactors, In: *AIChE Annual Meeting*, Pittsburgh PA, 2012.
52. **Bollas GM**, Du S**,** Valla IA. Biomass Gasification for Clean Energy Production. In: *UConn Engineering Tech Forum*. Storrs, CT, USA, 2012.
53. **Bollas GM**, Han L, Fischer A, Zhou Z**,** Optimal experimental design of chemical-looping combustion of syngas in fixed bed reactors, In: *UConn Engineering Tech Forum*. Storrs, CT, USA, 2012.
54. **Bollas GM**, Han L, Zhou Z, Du S, Fischer A. Biomass chemical-looping with oxygen uncoupling. In: *Chemical Engineering Approaches to Challenges in Energy and Biomedicine – NYAS*, New York, NY, USA 2012.

2011

55. **Zhou Z**, Bollas G.M. Chemical-looping combustion: Process design alternatives for increasing efficiency. In: *Abstracts of Papers of the American Chemical Society*. 2011.
56. Zhou Z, **Bollas GM.** Chemical-looping combustion: Process design alternatives for increasing efficiency. In: *241st ACS National Meeting & Exposition*, Anaheim, CA, USA, 2011.
57. Zhou Z**,** Navarro M, **Bollas GM**. Comparison of bench-scale fixed-bed units for chemical-looping combustion. In: *AIChE Annual Meeting*, 2011.
58. Du S, Valla IA, **Bollas GM**. A model-assisted tool for the characterization of char in biomass pyrolysis and biomass catalytic pyrolysis. In: *AIChE Annual Meeting*, 2011.
59. Du S, Valla, IA, **Bollas GM**, Design and initial testing of a spouted-bed reactor for biomass catalytic pyrolysis. In: *AIChE Annual Meeting*, 2011.
60. **Bollas GM**, Han L. H2 production options and their CO2 footprint. Invited Lecture, In: *SBE's Conference on Electrofuels Research - AIChE*, Providence, RI, 2011.

2010

61. **Bollas GM**, Orlicki D, Ma H. FCC selectivity studied in lab-scale units and pilot plants. In: *ACS Annual Meeting*, Boston, MA USA, 2010.

62. **Bollas GM**, Orlicki D, Ma H. Some uses and misuses of FCC catalyst testing experimental data, In: *AIChE Annual Meeting*, Salt Lake City UT USA, 2010.

Massachusetts Institute of Technology

2009

63. Mitsos A, **Bollas GM**, Barton PI. Parameter Estimation for Phase Equilibrium Models. In: *SIAM Computational Science and Engineering Conference*, Miami, FL, USA, 2009.
64. Mitsos A, **Bollas GM**, Barton PI. Model and Parameter Identification in Phase Equilibria, In: *ESCAPE 19*, Cracow, Poland. 2009

2008

65. Choi E, **Bollas GM**, Barton PI. Development of a Self-Consistent Database of Thermodynamic Properties of Sulfuric Acid and Hydrogen Iodide in a Wide Range of Composition, Temperature and Pressure. In: *2008 AIChE Annual Meeting*; Philadelphia, PA, USA; 2008
66. **Bollas GM**, Mitsos A, Barton PI. What Is the Number of Phases Predicted by Local Composition Models? Accurate Models Used In Inappropriate Ways. Invited Lecture. In: *AIChE Annual Meeting*, Philadelphia, PA, USA, 2008.
67. **Bollas GM**, Chen C-C, Barton PI. Refined Electrolyte-NRTL Model: Inclusion of Hydration for the Detailed Description of Electrolyte Solutions, In: *AIChE Annual Meeting*, Philadelphia, PA, USA, 2008.
68. **Bollas GM**, Smadbeck P, Barton PI, Simulation of Flowsheet Options for the HI Concentration and Decomposition Section of the Sulfur-Iodine Thermochemical Cycle. In: *AIChE Annual Meeting*, Philadelphia, PA, USA, 2008.
69. Chen C-C, Song Y, **Bollas GM**. Formulation and Behavior of a Symmetric Electrolyte NRTL Model for Gibbs Energy of Electrolyte Systems. Invited Lecture. In: *AIChE Annual Meeting*, Philadelphia, PA, USA, 2008.
70. Mitsos A, **Bollas GM**, Barton PI. Parameter Estimation for Phase Equilibrium Problems Via Bilevel Programs. In: *AIChE Annual Meeting*, Philadelphia, PA, USA, 2008.
71. Mitsos A, Lemonidis P, **Bollas GM**, Chachuat B, Barton PI, A Bilevel Framework for Process Design & Operation. In: *AIChE Annual Meeting*, Philadelphia, PA, USA, 2008.
72. Barton PI, **Bollas GM**, Ramirez-Munoz P, Kazimi MS. Dynamic Simulation of Nuclear Hydrogen Production Processes. Invited Lecture. In: *2008 Indo-American Frontiers of Engineering Symposium*, *National Academy of Engineering of the National Academies*, Irvine, CA, USA, 2008**.**

2007

73. **Bollas GM**, Kazimi MS, Barton PI. Detailed Modeling of the Thermodynamics of the Sulfur-Iodine Thermochemical Cycle. In: *AIChE Annual Meeting*, Salt Lake City, UT, USA, 2007.
74. **Bollas GM**, Chen C-C, Barton PI. The Significance of Mixing Rules, Hydration and Complex Formation in the electrolyte-NRTL Model. In: *AIChE Annual Meeting*, Salt Lake City, UT, USA, 2007.

Aristotle University of Thessaloniki

2008 – 2001

75. **GM Bollas**, I. Anastasiou, C. Ziogou, S. A. Papadopoulou, S. S. Voutetakis, P. Seferlis. A Non-Linear MPC Strategy for Conversion Targeting in a FCC pilot plant. In: *CAPE-Forum 2008*, Thessaloniki, Greece, 2008.

76. **GM Bollas**, I. Anastasiou, S.A. Papadopoulou, S.S. Voutetakis, P. Seferlis. Feed Conversion Targeting in an FCC Pilot Plant Using a Non-Linear MPC strategy. In: *American Control Conference ACC-2007*, New York, NY, USA, 2007.
77. S.S. Voutetakis, **GM Bollas**, I. Anastasiou, C. Ziogou, S.A. Papadopoulou, P. Seferlis. A Non-Linear MPC Strategy for Conversion Targeting in a FCC pilot plant. In: *PSE User's Meeting*, London, U.K., 2007.
78. **GM Bollas**, I. Anastasiou, C. Ziogou, S.A. Papadopoulou, S.S. Voutetakis, P. Seferlis. A Non-Linear MPC Strategy for Conversion Targeting in a FCC pilot plant – Development and Online Implementation. In: *NMPC-SOFAP 2007 Workshop*, Loughborough, U.K., 2007.
79. **GM Bollas**, I. Anastasiou, C. Ziogou, S. Voutetakis, S. Papadopoulou, P. Seferlis. Development of an Optimal Control System with Parameter Estimation for a Pilot Fluidized Catalytic Cracking (FCC) Unit. In: *6th Pan-Hellenic Scientific Congress in Chemical Engineering*, Athens, Greece, 2007.
80. **GM Bollas**, S. Avramidis, S.A. Papadopoulou, A.A. Lappas, S.S. Voutetakis, P. Seferlis. Model Predictive Control of a Fluid Catalytic Cracking Pilot Plant. Keynote Lecture. In: *9th Conference on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction (PRES2006) in the 17th International Congress of Chemical and Process Engineering (CHISA2006)*, Prague, Czech Republic, 2006.
81. **GM Bollas**, S.A. Papadopoulou, A.A. Lappas, S.S. Voutetakis, P. Seferlis, I.A. Vasalos. Application of a Model Predictive Control Strategy on a Fluid Catalytic Cracking Pilot Plant. In: *AIChE Annual Meeting*, San Francisco, CA, USA, 2006.
82. **GM Bollas**, A.A. Lappas, D.K. Iatridis, I.A. Vasalos. Development of a Five Lump Model with Selective Catalyst Deactivation for the Prediction of FCC Product Distribution, Based on Pilot Plant Data. In: *7th World Congress of Chemical Engineering WCCE-7*, Glasgow, Scotland, 2005.
83. **GM Bollas**, A.A. Lappas, S.S. Voutetakis, D.K. Iatridis, S.A. Papadopoulou. Development and Validation of a Dynamic Model for the Simulation of the Fluid Catalytic Cracking of CPERI. In: *5th Pan-Hellenic Scientific Congress in Chemical Engineering*, Thessaloniki, Greece, 2005.
84. **GM Bollas**, S.A. Papadopoulou, A.A. Lappas, S.S. Voutetakis, I.A. Vasalos. Dynamic Simulation and Optimization of the Fluid Catalytic Cracking Process. Application to the Pilot Plant of CPERI. Invited Lecture. In: *2nd International Exergy, Energy and Environment Symposium IEEES-2*, Kos, Greece, 2005.
85. **GM Bollas**, A.A. Lappas, D.K. Iatridis, I.A. Vasalos. An Integrated Riser-Regenerator Dynamic Model for the Simulation of Pilot and Commercial FCC Units. In: *4th European Conference on Chemical Engineering ECCE-4*, Granada, Spain, 2003.
86. J. Michalopoulos, **GM Bollas**, S. Papadokonstantakis, A.A. Lappas, G. Arampatzis, I.A. Vasalos, A. Lygeros. Modeling and Optimization of the Combined HDS and FCC Processes with a Computer-Aided Tool. In: *4th European Conference on Chemical Engineering ECCE-4*, Granada, Spain, 2003.
87. **GM Bollas**, A.A. Lappas, I.A. Vasalos. Dynamic Behavior of the Fluid Catalytic Cracking. Effect of the Feedstock Properties. In: *4th Pan-Hellenic Scientific Congress in Chemical Engineering*, Patra, Greece, 2003.

88. S. Papadokonstantakis, **GM Bollas**, J. Michalopoulos, A.A. Lappas, I.A. Vasalos, A. Lygeros Applying Fundamental and Neural Networks Theories in the Modeling of a Commercial FCC Unit. In: *15th International Congress of Chemical and Process Engineering – CHISA 2002*, Prague, Czech Republic, 2002.
89. **GM Bollas**, A.A. Lappas, I.A. Vasalos. An Integrated Riser-Regenerator Dynamic Model for the Simulation of Pilot and Commercial FCC Units. In: *1st Scientific Meeting of CPERI - Research Activities and Future Development of CPERI.* Thessaloniki, Greece, 2002.
90. **GM Bollas**, A.A. Lappas, I.A. Vasalos. Pressure Balance in a Fluid Catalytic Cracking Riser. In: *3rd Pan-Hellenic Scientific Congress in Chemical Engineering*, Athens, Greece, 2001.

Advising Students' Honors and Awards:

- Oscar Nordness (Undergraduate Student – UConn): 2nd Place Award - AIChE Undergraduate Student Poster Competition.
- Clarke Palmer (Undergraduate Student – UConn): 3rd Place Award - AIChE Undergraduate Student Poster Competition.
- Ari Fischer (Undergraduate Student – UConn): 3rd Place Award - AIChE Undergraduate Student Poster Competition.
- Oscar Nordness (Undergraduate Student – UConn): 2nd Place Award - AIChE Undergraduate Student Poster Competition.
- Joshua Lansford (REU Undergraduate Scholar – University of Virginia): 2nd Place Award - AIChE Undergraduate Student Poster Competition.
- Eugene Choi (Undergraduate Student - MIT): 1st Place Award - AIChE Undergraduate Student Poster Competition.
- Lu Han (PhD Candidate – UConn): NSF GK-12 Fellow 2012-2013, UTC-IASE Fellow 2014, CT Women of Innovation Finalist 2014.
- Kyle Palmer (PhD Candidate – UConn): UTC-IASE Fellow 2014-2015.
- William Hale (PhD Candidate): UTC-IASE Fellow 2014-2015.
- Oscar Nordness (Undergraduate Researcher – UConn): NSF REU Fellow 2014 (Auburn U.).
- Ari Fischer (Undergraduate Researcher – UConn): UConn IDEA Scholar 2012, CT NASA Space Grant Scholar 2013, Udall Fellow 2014.

Research Grants (*in chronological order*):

1. CAREER: Simulation and Design of Chemical-Looping Combustion and Reforming Processes
   Georgios Bollas (PI) **SPONSOR:** National Science Foundation
   FUNDING PERIOD: 07/01/11 – 06/30/16 **AWARD:** $400,000
2. CAREER: Simulation and Design of Chemical-Looping Combustion – REU Supplement
   Georgios Bollas (PI) **SPONSOR:** National Science Foundation
   FUNDING PERIOD: 07/15/12 – 06/30/16 **AWARD:** $10,000
3. Optimization of FCC Selectivity Through Detailed Modeling of Catalyst Evaluation Experiments and the Contributions of Catalyst Components
   Georgios Bollas (PI) **SPONSOR:** W.R. Grace & Co. (matched by DOE)
   FUNDING PERIOD: 08/01/10 – 07/31/12 **AWARD**: $114,000

Georgios Bollas (PI) **SPONSOR:** Department of Energy (matched by W.R. Grace & Co.)
FUNDING PERIOD: 08/01/10 – 07/31/12 **AWARD**: $116,294

4. Advanced Coal-Biomass-To-Liquid (CBTL) Systems Configurations and Efficiency Analysis
   Georgios Bollas (PI) **SPONSOR:** Connecticut Center for Advanced Technologies
   FUNDING PERIOD: 03/01/11 – 12/31/11 **AWARD:** $178,235
5. MRI: Acquisition of a State-of-the-art Small Angle X-Ray Scattering (SAXS) Instrument for Research and Education
   Mu-Ping Nieh (PI), Georgios Bollas (co-PI) **SPONSOR:** National Science Foundation
   FUNDING PERIOD: 08/25/12 **AWARD:** $568,398
6. Turning Tars into Energy: Zeolites with Hierarchical Pore Structure for the Cracking of Tars
   Ioulia Valla (PI), Georgios Bollas (co-PI) **SPONSOR:** National Science Foundation
   FUNDING PERIOD: 08/23/12 – 08/22/15 **AWARD:** $188,698
7. Gasoline Selective Fischer-Tropsch Synthesis in Structured Catalytic Reactors
   Georgios Bollas (PI) **SPONSOR:** American Chemical Society – Petroleum Research Fund – Doctoral New Investigator Award
   FUNDING PERIOD: 08/23/13 – 08/22/15 **AWARD:** $100,000
8. Systems Approach on Advanced Utilization and Exploration of Dynamic Models of Thermal Fluid Applications
   Georgios Bollas (PI) **SPONSOR:** United Technologies Corporation
   FUNDING PERIOD: 01/01/14 – 12/31/18 **AWARD:** $511.274
9. Systems Approach on Advanced Utilization and Exploration of Dynamic Models of Thermal Fluid Applications – Foreign Travel Supplement
   Georgios Bollas (PI) **SPONSOR:** United Technologies Corporation
   FUNDING PERIOD: 01/01/14 – 12/31/14 **AWARD:** $20.388
10. Dynamic Simulation and Real-Time Optimization of Power Plant Operations
    Georgios Bollas (PI) **SPONSOR:** Alstom Power, Inc.
    FUNDING PERIOD: 09/01/14-12/31/15 **AWARD:** $56.506
11. Supervisory Control Synthesis for Energy-Efficient BIS Chiller Plants
    Gupta Shalabh (PI), Georgios Bollas (co-PI) **SPONSOR:** United Technologies Corporation
    FUNDING PERIOD: 01/01/15-12/31/15 **AWARD:** $202,000
12. STTR Phase II: Technologies for Rare Earth Enrichment o fa Novel Low Cost Raw Material
    Georgios Bollas (UConn PI with Physical Sciences, Inc.) **SPONSOR:** Office of Naval Research
    FUNDING PERIOD: 02/15/15 – 08/30/16 **AWARD:** $1,000,000
13. Value-Added Uses for Polyethylene Terephthalate Derived From Post-Consumer PET Carpets
    Richard Parnas (PI), Georgios Bollas (co-PI) **SPONSOR:** Carpet American Recovery Act
    FUNDING PERIOD: 01/19/15 – 07/18/16 **AWARD:** $435,094

Teaching and Curricula Development:

- **CHEG-4142:** Unit Operations & Process Simulation - 2011-2014 (senior level core CHEG course – 2014 Student Evaluations: 5/5)

- **CHEG-4995:** Computer Simulation in Chemical Engineering - 2012-2014 (senior undergraduate and graduate level CHEG elective course – 2014 Student Evaluations: 5/5)
- **SE-5101:** Foundations of Thermal Fluid Systems - 2014 (graduate-level course offered in UTC).
- **CHEG-4143:** Process Dynamics & Control - 2010-2011 (senior level core CHEG course)

Teaching Summary:

Currently, Dr. Bollas is teaching the core undergraduate-level course "Unit Operations and Process Simulation" to an average of 50 senior Chemical Engineering students every year. He also teaches and the elective course "Computer Simulation in Chemical Engineering," which is offered to 22 senior and junior level undergraduate Chemical Engineering students. Both courses receive the highest teaching evaluations among all the courses offered in the Department of Chemical and Biomolecular Engineering of UConn. For this reason Dr. Bollas received the Provost's Award from Provost Mun Choi, noting that Dr. Bollas is among a select group of faculty who excel in teaching. In the following a brief overview of Dr. Bollas' teaching activity and philosophy is provided.

Teaching Innovations:

- Modelica computer lab modules for the UTC-IASE Course "SE 5101 TFS Foundations"
- Matlab computer lab modules for the course "Computer Simulations in Chemical Engineering"
- Comsol computer lab modules for the course "Computer Simulations in Chemical Engineering"
- Development of student oriented project with the objective of process simulation aligned with the senior Capstone Design project (in the course "Computer Simulations in Chemical Engineering")
- Research-oriented student project on the simulation, efficiency estimation and greenhouse gas emissions of biomass-fed chemical-looping processes (aligned with the NSF CAREER Project "simulation and design of chemical-looping combustion, NSF-CBET" as part of the course "Unit Operations and Process Simulation"

CHEG-4142 – "Unit Operations and Process Simulation" The teaching philosophy in this course forms around an interactive, bi-directional integration of research and teaching, using research-oriented problems. The result of this teaching approach is that:

a) Students earn experience in addressing challenging research oriented problems.
b) They are prepared to give presentations of their work, interact with their classmates and answer questions regarding their solution approach.
c) They become acquainted with typical process simulation software.

This teaching philosophy is an effort to integrate research into teaching, integrate students into research and work in groups. The heart of this course is learning the basic principles of unit operations and applying modern tools for computer simulation of chemical engineering processes. Theory sessions cover the basic elements of unit operations (*e.g.*, chemical reactors, heat exchangers, distillation columns, etc.) and interactive computer labs cover computer simulation using Chemical Engineering software (Aspen Plus). Every year a different, modern

design challenge problem is offered, inspired by Dr. Bollas' research activity. Projects like power generation with CO_2 mitigation, design of bio-refineries, production of H_2 from biomass, and Fischer Tropsch Synthesis for the production of synthetic fuels have been offered in the past years. These design projects focus on thermodynamic analysis, systems and heat integration, efficiency analysis, and process economics. Students working in groups integrate flowsheet components and units, perform basic heat integration, estimate the plant efficiency and cost and compare it to conventional technologies. Overall, the course project serves three purposes:

a) To generate awareness of modern chemical engineering challenges, such as CO_2 mitigation, renewable energy, alternative fuels, etc.
b) To challenge students to think about an intriguing problem, a modern chemical engineering challenge, for which the solution is within the material covered in the class.
c) To propose a process that addresses this challenge, design the process flowsheet, compare it to current solutions and evaluate its efficiency and bottlenecks.

CHEG-4995 – "Computer Simulation in Chemical Engineering" This elective course is offered to junior and senior Chemical Engineering undergraduate students, as well as graduate students. The course is offered to 26 students in the spring semester of 2015, 22 of which are undergraduates. This course started as a derivative of and commitment to Dr. Bollas' NSF CAREER Award and has evolved into the most popular CHEG elective. The course focuses on the simulation of chemical reactors, chemical reactions with diffusional limitations, mass and heat transfer and transport phenomena. The focus of the course is on the mathematical and computational aspects of solving the partial differential equations and differential algebraic equations governing the solution of common reactor engineering problems. By the end of this course, students are expected to:

a) Exhibit proficiency in simulating chemical reactors, and separation and mixing systems, at different levels of complexity, using Matlab and Comsol.
b) Develop, solve and analyze process models by applying fundamental concepts from physics, biology, chemistry and mathematics.
c) Demonstrate the ability to simulate reacting flows by explaining model assumptions, writing governing equations, and solving the equations using mathematical programming.
d) Identify, analyze, solve, and present a modern challenge in Chemical Engineering.

The course includes an extensive set of interactive computer laboratory sessions, as well as theory sessions on the principles of chemical reactor engineering and the corresponding mathematical aspects. Additionally, a student-oriented project is offered, termed the "Do It Yourself" (DIY) project. Overall, the DIY project challenges students to think of an intriguing problem, relative to their research or interests, for which the solution is within the material covered in the class. The novelty here is that the project problem is identified by the students in collaboration with the instructor. Graduate students typically identify their DIY problem from their research. Undergraduate students identify their DIY problem from their Independent Research Studies, or their interest in a specific aspect of Chemical Engineering covered in class. In essence, students are provided with the opportunity to select their midterm exam problem, and they have been very responsive and enthusiastic about this.

SE-5101 – "Foundations of Thermal Fluid Systems" This course is offered in the Center for Teaching Excellence of the United Technologies Corporation headquarters in Windsor Locks, CT. It represents a new initiative of the UConn/UTC Institute for Advanced Systems Engineering (IASE) to externalize education beyond the university campus and train young engineers at their workplace. The course is designed to provide students with the foundations of thermal fluid system modeling and computational methods for performance analysis. The students develop skills in the fundamental physical and mathematical representations of fluid dynamics, thermodynamics, and heat transfer. Topics include thermal fluid system and component governing equations, creation of thermal fluid system models with different levels of abstraction and design analysis for thermal fluid systems. The course is addressed to students in engineering who are pursuing the System Modeling and Robust Design or Controlled Systems curriculum tracks of IASE. Dr. Bollas is the coordinator of the Controlled Systems curriculum track and the main course instructor of SE-5101.

Outreach Activities:

- Joule Fellows program (sponsored by the NSF)
  - Summer 2011: Darpan Patel, teacher at Big Picture High School, Bloomfield-CT
  - Summer 2012: Diane Pintavalle, teacher at Glastonbury High School, Glastonbury-CT
  - Summer 2014: Jon Hand, teacher at Mansfield Middle School, Mansfield-CT
- Development of program for the introduction to research of students of the Glastonbury High School.
- UCONN Mentor Connection 2014: two high schools students worked in research projects.

University Service (UConn):

- Capstone Senior Design Committee
- Graduate Admissions Committee
- UTC-IASE Curriculum Track Coordinator
- UTC-IASE Fellowships Evaluation Committee
- Advisor in the Joule Fellows Program
- C2E2 Safety & Ops Committee
- C2E2 Publicity Committee

Extramural Service:

- Participant: "Workshop on Combinatorial Approaches to Functional Materials" of the White House Office of Science and Technology Policy (OSTP)
- Review Panel: NSF GRFP
- Review Panel: NDSEG: DOD/ASEE
- Review Panel: DOE Office of Science Graduate Fellowship Program
- Review Panel: federal peer review for the National Energy Technology Laboratory, Department of Energy
- Ad-hoc reviewer: NSF CyberSEES, ad-hoc reviewer
- Chair: Applied Chemical Technology Subdivision (ACTS) of the American Chemical Society (ACS)

- Conference Organizer: Undergraduates Collaborating for the Future, 241 ACS Annual Meeting 2011, Anaheim CA
- Editorial Member:
  - Editorial Board Member of the Journal of Energy and Chemical Engineering
  - Editorial Board Member the Open Catalysis Journal
  - Editorial Board Member Austin Chemical Engineering, Austin Publishing Group
  - Review Editor for the Frontiers in Energy Research Journal.
- Reviewer for over 20 top Scientific Journals

Professional Memberships:

- AIChE: Senior member, 2006-present
- Sigma Xi, The Scientific Society - MIT Chapter: Member, 2009-present
- ACS: Member, 2007-present
- Technical Chamber of Greece: Member, 2001-present
- Hellenic Chemical Engineering Society: Member, 2001-present
- AAUP: Member, 2010-present