

Simcha Singer

- ◆ Marquette University, Dept. of Mechanical Engineering ◆
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PROFESSIONAL EXPERIENCE

Assistant Professor, Dept. of Mechanical Engineering, Marquette University August 2014-present

FIELDS OF SPECIALIZATION

- Combustion and Gasification of Porous Solids Fuels
- Multicomponent Droplet Vaporization
- Surrogate Fuels
- Pyrolysis

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA

Post-Doctoral Associate, Dept. of Chemical Engineering 2012-2014

PhD in Mechanical Engineering June 2012
Thesis: Gasification and Combustion Modeling of Porous Char Particles

MS in Mechanical Engineering September 2006
Thesis: Low Pt-Loading Electrospun Electrodes for Proton Exchange Membrane Fuel Cells

Northwestern University, Evanston, IL

BS in Mechanical Engineering, Magna Cum Laude June 2004

PUBLICATIONS (PEER-REVIEWED JOURNALS)

- S. Jorgensen, **S. Singer**, "Micro-CT-based Approaches for Quantifying the Morphology of Pulverized Char Particles" *Energy & Fuels*, 33 (6), 4826-4834, 2019.
- A. Cooney, **S. Singer**, "A hybrid droplet vaporization-chemical surrogate approach for emulating vaporization, physical properties, and chemical combustion behavior of multicomponent fuels" *Proceedings of the Combustion Institute*, 37, 3229-3236, 2019.
- Z. Liu, **S. Singer**, D. Zitomer, and P. McNamara. "Sub-pilot-scale Autocatalytic Pyrolysis of Wastewater Biosolids for Enhanced Energy Recovery." *Catalysts*, 8, 524-534, 2018.
- G. Fong, S. Jorgensen, and **S. Singer**, "Pore-Resolving Simulation of Char Particle Gasification Using Micro-CT" *Fuel*, 224, 752-763, 2018.
- Z. Liu, **S. Singer**, Y. Tong, L. Kimbell, E. Anderson, M. Hughes, D. Zitomer, P. McNamara, "Characteristics and Applications of Biochars Derived from Wastewater Solids," *Renewable and Sustainable Energy Reviews*, 90, 650-664, 2018.
- A. Cooney, **S. Singer**, "Modeling Multicomponent Fuel Droplet Vaporization with Finite Liquid Diffusivity using the Direct Quadrature Method of Moments with Delumping," *Fuel*, 212, 554-565, 2018.
- J. Li, **S. Singer**, "An efficient coal pyrolysis model for detailed tar species vaporization," *Fuel Processing Technology*, 171, 248-257, 2018.

S. Singer, “Direct Quadrature Method of Moments with Delumping for Modeling Multicomponent Droplet Vaporization,” *International Journal of Heat and Mass Transfer*, 103, 940-954, 2016.

S. Singer, L. Chen, and A. F. Ghoniem, “The Influence of Gasification Reactions on Char Consumption under Oxy-Combustion Conditions: Effects of Particle Trajectory and Conversion,” *Proceedings of the Combustion Institute*, 34, (2), 3471–3478, 2013.

S. Singer and A. F. Ghoniem, “Comprehensive Gasification Modeling of Char Particles with Multi-Modal Pore Structures”, *Combustion and Flame*, 160, (1), 120–137, 2013.

S. Singer and A. F. Ghoniem, “An Adaptive Random Pore Model for Multi-Modal Pore Structure Evolution with Application to Char Gasification,” *Energy and Fuels*, 25 (4), 1423-1437, 2011.

PUBLICATIONS (CONFERENCES)

S. Singer, “Modifying continuous thermodynamics droplet vaporization models to predict functional group fluxes” U.S. National Combustion Meeting, March 2019.
(Not Peer-reviewed)

S. Jorgensen, **S. Singer**, “Pore-resolving simulation to study the effect of morphology on char combustion” U.S. National Combustion Meeting, March 2019.
(Not Peer-reviewed)

A. Cooney, **S. Singer**, “Modeling high-pressure multicomponent droplet vaporization using quadrature moment methods with delumping and the Peng-Robinson equation of state” ICLASS 2018: 14th International Conference on Liquid Atomization and Spray Systems, Institute for Liquid Atomization and Spray Systems, July 2018.
(Peer-reviewed)

A. Cooney, **S. Singer**, “A Droplet Vaporization-Adaptive Surrogate Model Applied to Jet Fuels” 2018 Spring Technical Meeting, Central States Section of the Combustion Institute, May 2018.
(Not Peer-reviewed)

S. Jorgensen, **S. Singer**, “Single Particle, Pore-Resolving Simulation of Coal Char Oxy-Combustion”, 2018 Spring Technical Meeting, Central States Section of The Combustion Institute, Minneapolis, MN. May 2018.
(Not Peer-reviewed)

Z. Liu, **S. Singer**, D. Zitomer, P. McNamara, “Can Autocatalytic Pyrolysis of Wastewater Biosolids be Energy Neutral and Generate Value-Added Products?” *Proceedings of the Water Environment Federation.*, pp. 360-364, 2017.
(Peer-reviewed)

S. Singer, J. Cai, W. H. Green, “Detailed Modeling of Pyrolysis of Large Lignite Particles”, *Proceedings of the 40th International Technical Conference on Clean Coal and Fuel Systems*, pp. 278-289, 2015.
(Not Peer-reviewed)

M. Kumar, R. F. D. Monaghan, **S. Singer**, C. Zhang, and A. F. Ghoniem, “CFD Simulation of Entrained Flow Gasification with Improved Devolatilization and Char Consumption Submodels”, *Proceedings of the ASME IMECE*, 2009, Vol. 3, pp. 383-395, 2009.

R. F. D. Monaghan, M. Kumar, **S. Singer**, C. Zhang and A. F. Ghoniem, “Reduced Order Modeling of Entrained Flow Solid Fuel Gasification”, *Proceedings of the ASME IMECE*, 2009, Vol. 3, 397-409.

PRESENTATIONS

S. Singer, "Modifying continuous thermodynamics droplet vaporization models to predict functional group fluxes" U.S. National Combustion Meeting, Pasadena, CA, March 26, 2019.

S. Jorgensen, S. Singer, "Pore-resolving simulation to study the effect of morphology on char combustion" U.S. National Combustion Meeting, Pasadena, CA, March 25, 2019.

A. Cooney, S. Singer, "A hybrid droplet vaporization-chemical surrogate approach for emulating vaporization, physical properties, and chemical combustion behavior of multicomponent fuels" International Combustion Symposium, Dublin, Ireland, July 31, 2018.

Cooney, A., Singer S., "Modeling high-pressure multicomponent droplet vaporization using quadrature moment methods with delumping and the Peng-Robinson equation of state" ICLASS 2018: 14th International Conference on Liquid Atomization and Spray Systems, Institute for Liquid Atomization and Spray Systems, Chicago. July 26, 2018.

Cooney, A., Singer S., "A Droplet Vaporization-Adaptive Surrogate Model Applied to Jet Fuels" 2018 Spring Technical Meeting, Central States Section of the Combustion Institute, Minneapolis, MN, May 22, 2018.

Jorgensen, S., Singer S., "Single Particle, Pore-Resolving Simulation of Coal Char Oxy-Combustion", 2018 Spring Technical Meeting, Central States Section of The Combustion Institute, Minneapolis, MN. May 22, 2018.

Tong, Y., McNamara, P.J., Singer, S.L., Mayer, B.K. The Thermodynamics of Attachment: Enthalpy and Free Energy of Adsorption of Neutral and Ionic Micropollutants on Biosolids-derived biochar. *255th ACS National Meeting*. New Orleans, LA, March 20, 2018.

Liu, Zhongzhe, Simcha L Singer, Daniel H. Zitomer, and Patrick McNamara, "Biochar from Wastewater Biosolids: Solids Management to Advance Sustainable Communities", AEEESP 2017 Research & Education Conference, June 2017.

Liu, Z, Singer, S., McNamara, P., Zitomer, D, "Can Autocatalytic Pyrolysis of Wastewater Biosolids be Energy Neutral and Generate Value-Added Products?" Presented at Residuals and Biosolids Conference, Seattle, WA, April 2017.

Singer, S., "Detailed Modeling of Pyrolysis of Large Lignite Particles", *40th International Technical Conference on Clean Coal and Fuel Systems*, Clearwater, FL, June 2015

Singer, S., Green W. H., "Numerical Simulation of Forward and Static Smoldering Combustion," *COMSOL Conference 2013*, Newton, MA, October 2013.

Singer, S., Chen, L. and Ghoniem, A. F., "The Influence of Gasification Reactions on Char Consumption under Oxy-Combustion Conditions: Effects of Particle Trajectory and Conversion," *34th International Symposium on Combustion*, Warsaw, Poland, August 2012.

GRANTS

Singer, S. (PI). Adaptive Surrogate Models for High Pressure Combustion. Opus College of Engineering, Wallace Fund, 9/2018-5/2019; \$20,000.

Borg, J. (PI), Coutu, R. (co-PI), Roy, S. (co-PI), **Singer, S.** (co-PI), Connecting Experiments and Simulations while Designing Functionality into the Dynamic Behavior of Surrogate Energetic Systems. Air Force Office of Scientific Research, 9/30/2018–9/29/2023; \$1,502,289.

Singer, S. (PI). Pore-Resolving Simulations of Coal Gasification using Micro-CT Imaging. American Chemical Society – Petroleum Research Fund, 9/2016-8/2018; \$110,000.

McNamara, P. (PI), **Singer, S.** (Co-PI), Liu, Z. (Co-PI). Pilot-Scale Pyrolysis: [Auto-] Catalysis to Improve Yields and Quality. Milwaukee Metropolitan Sewerage District. 7/2016-8/2017; \$156,936.

Singer, S. (PI), LaDisa J. (Co-PI). Modeling Chemical Deposition in the Human Airway from Electronic Cigarettes. Marquette University – Opus College of Engineering Seed Grant, 7/2016-6/2017; \$75,000.

McNamara, P. (PI), Mayer, B. (Co-PI), **Singer, S.** (Co-PI). Removal of Pollutants from Contaminated Fluids using a Novel Adsorbent: Combining Experiments and Modeling to Decipher Fundamental Mechanisms, Marquette University – Opus College of Engineering Seed Grant, 1/2017-12/2017; \$75,000.

Singer, S. (PI), McNamara, P.J. (Co-PI). Thermo-Gravimetric Analyzer (TGA) System, Marquette University – Opus College of Engineering Equipment Grant, 7/2016-6/2017; \$39,900.

Singer, S. (PI). Hybrid Models to Reduce the Computational Cost of Simulating Energy Conversion Processes– Marquette University ORSP Regular Research Grant, 5/2016-8/2016; \$5,500

ADVISING

Theses Directed

-Graduated

Jianqing Li, *Modeling Pyrolysis of Large Coal Particles with Many Species*, M.S. November 2016

Greg Fong, *Pore-Resolved Simulations of Char Particle Gasification*, M.S. May 2017

Alanna Cooney, *Computational Methods for Modeling Multicomponent Droplet Vaporization*, M.S. May 2018

-Current

Scott Jorgensen, *Pore-Resolved Simulations of Char Particle Combustion*, M.S. Anticipated May 2019

William Kreutter, *Biosolids pyrolysis: Experiments and Modeling*, M.S. Anticipated May 2019

Dongyu Liang, *Untitled*, Ph.D., Anticipated

Dissertation/Thesis Committee Member

David Wilson, M.S., April 2016, Casey Allen chair

Logan Beaver, M.S., May 2017, John Borg chair

Jenna Ezzell, M.S., May 2017, Casey Allen chair

Yiran Tong, Ph.D., March 2018, Patrick McNamara and Brooke Mayer chairs

Jonathan Bruss, M.S., July 2018, John Borg chair

Woojae Chung, M.S., November 2018, Chunghoon Lee chair

Joseph Farmer, M.S., April 2019, Somesh Roy chair

Dylan Lehmier, M.S., April 2019, Casey Allen chair

David Wilson, Ph.D, April 2019, Casey Allen chair

David Roulo, M.S., June 2019, Casey Allen chair

Ashley Hatzenbihler, M.S., June 2019, Casey Allen chair

Khaledmoharrar Mukut, M.S. June 2019, Somesh Roy chair

Tim Kerrigan, Ph.D. Anticipated, Phil Voglewede chair

Undergraduate Researchers

Renata Vinhas (Fall 2015)

Yuxing Zhang (Summer 2016)

Jonathan Blanchard (Spring 2017)

William Kreutter (Spring 2017)

Scott Jorgensen (Spring 2017)

Michael Hayes (Spring 2019 – Summer 2019)

Senior Design Teams/Sponsors

M80/Briggs and Stratton (2015-2016)
M82/Briggs and Stratton (2016-2017)
M99/Grumman Butkus Associates (2016-2017)
M74/Modine (2017-2018)

TEACHING

Dept. of Mechanical Engineering, Marquette University

Courses taught:

Thermodynamics I (MEEN 3310), an undergraduate course (Fall 2014 - Spring 2019)
Intermediate Thermodynamics (MEEN 4360/5360), graduate/undergraduate course (Spring 2017, 2018, 2019)

Courses developed and taught:

Radiation Heat Transfer (MEEN 6340), a graduate course (Fall 2016, Fall 2017)
Mass Transfer (MEEN 6931), a graduate course (Fall 2018)

Dept. of Mechanical Engineering, MIT

TA for *Fundamentals of Advanced Energy Conversion*, a graduate/undergraduate course (Spring 2008)

SERVICE

MEEN Graduate Committee (2014-2015)
MEEN Faculty Search Committee (2015-2016)
MEEN Undergraduate Committee (2016-2017)
MEEN Faculty Search Committee (2017-2018)
MEEN Undergraduate Committee (2018-2019)
MEEN Department Secretary (2018-present)
Tau Beta Pi – Faculty Advisor (2016-present)

Referee for:

AIChE Journal
Brazilian Journal of Chemical Engineering
Combustion and Flame
Fuel
Energy and Fuels
Fuel Processing Technology
Proceedings of the Combustion Institute

HONORS/AWARDS

Distinguished Paper Award in the *Spray, Droplet, and Supercritical Combustion* section for the 37th International Symposium on Combustion, January 16, 2019

Outstanding Teacher in Mechanical Engineering for 2017-2018, April 20, 2018

MEMBERSHIP

Combustion Institute
Tau Beta Pi
