Colin H. Smith
PhD Candidate

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RESEARCH INTERESTS AND GOALS

I am interested in combustion and other reacting flows. More generally I am interested in transport and chemical kinetics. My primary goal is to advance our knowledge of reacting flows through experimentation and modeling so that technologies may be developed for the public interest.

EDUCATION

University of Texas at Austin, Cockrell School of Engineering
PhD – Mechanical Engineering (Thermal-Fluid Systems) Dec 2012
Advised by Prof. Janet Ellzey
Non-Major Focus Area: Philosophy
GPA 3.7/4.0

University of Texas at Austin, Cockrell School of Engineering
MS – Mechanical Engineering May 2009
Advised by Prof. Janet Ellzey and Prof. Michael Webber

Cornell University, Sibley School of Mechanical Engineering
BS – Mechanical Engineering May 2004

RESEARCH EXPERIENCE

Graduate Research Assistant, UT-Austin (Ellzey Combustion Laboratory) 2007 - Present

Under Professor Janet Ellzey, I conduct research on rich and ultra-rich combustion, which requires preheating reactants. In one type of reactor that I use for study, the reactants are preheated by stabilizing a reaction zone within the pores (D~5mm) of an inert medium. During operation heat is transferred upstream through the porous medium by solid conduction and radiation. The porous solid acts as a transport enhancement relative to the transport that would occur in a 1-D laminar flame, allowing significant heat transfer by radiation and solid conduction and enhancing gas phase diffusion processes by dispersion, which is caused by the tortuosity of the fluid pathway. I studied the ability of this type of reactor to produce syngas from reactions of mixtures with rich and ultra-rich equivalence ratios and examined the ability of a computational model to predict the experimental observations. To investigate some of the more basic characteristics of very rich combustion, I use a flat flame burner, which allows for optical access to the reaction zone and has much simpler transport processes than a porous media burner. My current work includes understanding the effect that preheating has on the conversion of fuels to syngas and investigating the potential difficulties in modeling the combustion of very rich fuel/air mixtures.

Graduate Research Assistant, UT-Austin (Webber Energy Group) 2007 - 2009

I conducted research under Professor Michael Webber on system-level analyses of biofuels. I studied the system-level energy flows in the conversion of wet ethanol to syngas by filtration combustion. I also developed and published, with another graduate student, a framework to report research results for the production of biodiesel from algae.

Undergraduate Research Assistant, Cornell University (Gouldin Combustion Laboratory) 2002 - 2004

I conducted research on the development of a novel system for measuring CH* chemiluminescence in flames under the guidance of Professor Frederick Gouldin. I designed the experimental apparatus, including a LabVIEW control system, and key components for the measurement system, which was based on a 35 mm camera and an array of photodiodes. I tested and analyzed the capabilities of the measurement system through experimentation and data analysis using Matlab.

Undergraduate Design Project - Cornell High Energy Synchrotron Source (CHESS) 2003 - 2004

For my senior design project at Cornell, I selected to work independently for a physicist, Dr. Charles Sinclair at CHESS while supervised by Professor Elizabeth Fisher. I designed a beam dump for a 1.3 MW, 13 MEV electron beam. The design process included heat transfer analysis, thermal stress analysis, material selection and manufacturability. I used ANSYS for detailed heat transfer and stress modeling. My work resulted in a conference paper published in the Proceedings of the 2005 Particle Accelerator Conference.

PUBLICATIONS

Archival Papers

C.H. Smith, D.I. Pineda, J.L. Ellzey, "Syngas Production from Burner-stabilized Methane/Air Flames: The Effect of Preheated Reactants," Submitted to Combustion and Flame

C.H. Smith, C.D. Zak, D.I. Pineda, J.L. Ellzey, "Conversion of Jet Fuel and Butanol to Syngas via Filtration Combustion," In Preparation for Submission to The International Journal of Hydrogen Energy

C.H. Smith, D.M. Leahey, L.E. Miller, J.L. Ellzey, "Conversion of Wet Ethanol to Syngas via Filtration Combustion: an Experimental and Computational Investigation," Proceedings of the Combustion Institute 2011, Volume 33, Issue 2, Pages 3317-3324

C.M. Beal, **C.H. Smith**, M.E. Webber, R.S. Ruoff, R.E. Hebner, "A Framework to Report the Production of Biodiesel from Algae," BioEnergy Research, August 12, 2010. (DOI 10.1007/s12155-010-9099-x)

Conference Papers

C.H. Smith, D.I. Pineda, J.L. Ellzey, "Rich Combustion for Syngas Production: Comparisons Between Experiments and Modeling," 2011 Fall Technical Meeting, Western States Section of the Combustion Institute, Riverside, CA, October 16-18, 2011

C.H. Smith, C.D. Zak, D.I. Pineda, J.L. Ellzey, "Conversion of Jet Fuel to Syngas via Filtration Combustion," Paper N18, 7th US National Combustion Meeting, Atlanta, GA, March 20-23, 2011

C.H. Smith, C.D. Zak, J.L. Ellzey, "Conversion of Bio-Butanol to Syngas via Filtration Combustion", 2010 Spring Technical Meeting, Western States Section of the Combustion Institute, Boulder, CO, March 21-23, 2010

C.H. Smith, D.M. Leahey, L.E. Miller, J.L. Ellzey and M.E. Webber, "Conversion of Wet Ethanol to Syngas and Hydrogen," ASME Paper ES2008-54215 and Presentation, ASME Energy Sustainability 2008 Conference, Jacksonville, FL, August 10-14, 2008 – Won Best Paper Award given by Advanced Energy Systems Division of ASME

Colin H. Smith, Yun He, Charles Sinclair. “Design for a 1.3MW, 13 MEV Beam Dump for an Energy Recovery Linac”, Proceedings of 2005 Particle Accelerator Conference, Knoxville, TN, May 16-20, 2005 (www.lns.cornell.edu/public/ERL/2005/ERL05-4/erl05-4.pdf)

A.R. Broadfoot, A.D. Cuellar, M.J. O'Donnell, **C.H. Smith**, M.E. Webber, "Next Generation Biofuels - Trends In Global Innovation and Finance: The Tools of Biotechnology Meet the World's Energy Challenge", UK Trade and Investment Conference, Houston, TX, October 2007.

SCHOLARLY PRESENTATIONS AND POSTERS

C.H. Smith, D.I. Pineda, J.L. Ellzey, "Rich Combustion for Syngas Production: Comparisons Between Experiments and Modeling," 2011 Fall Technical Meeting, Western States Section of the Combustion Institute, Riverside, CA, October 16-18, 2011

C.H. Smith, C.D. Zak, D.I. Pineda, J.L. Ellzey, "Conversion of Jet Fuel to Syngas via Filtration Combustion," Paper N18, 7th US National Combustion Meeting, Atlanta, GA, March 20-23, 2011

C.H. Smith, C.D. Zak, J.L. Ellzey, "Conversion of Bio-Butanol to Syngas via Filtration Combustion", 2010 Spring Technical Meeting, Western States Section of the Combustion Institute, Boulder, CO, March 21-23, 2010

C.H. Smith, D.M. Leahey, L.E. Miller, J.L. Ellzey, "Conversion of Wet Ethanol to Syngas via Filtration Combustion: an Experimental and Computational Investigation," Presentation at the 33rd International Symposium on Combustion, Beijing, China, August 1-6, 2010

C.H. Smith, E.B. Belmont, J.L. Ellzey,"Noncatalytic Reforming of Liquid Hydrocarbons to Syngas for Applications in Portable Power Systems," Presentation, AFOSR-NASA Hypersonics Research Review, Cleveland, OH, June 7-10, 2010

C.H. Smith, I.M Schoegl, S.R. Newcomb, J.L. Ellzey, "Noncatalytic Partial Oxidation for Syngas Production," Presentation, AIChE Spring National Meeting, Tampa, FL, April 26-30, 2009

C.H. Smith, D.M. Leahey, L.E. Miller, J.L. Ellzey and M.E. Webber, "Conversion of Wet Ethanol to Syngas and Hydrogen," ASME Paper ES2008-54215 and Presentation, ASME Energy Sustainability 2008 Conference, Jacksonville, FL, August 10-14, 2008 – Won Best Paper Award given by Advanced Energy Systems Division of ASME

C.H. Smith, D.I. Pineda, J.L. Ellzey, "Rich Combustion for Syngas Production; Comparisons Between Experiments and Modeling," Poster, 7th US National Combustion Meeting, Atlanta, GA, March 20-23, 2011

TEACHING EXPERIENCE

Teaching Assistant for Undergraduate Fluid Mechanics Course, UT-Austin **2012**

I held regular office hours, prepared homework solutions and conducted test review sessions as the sole TA for a class of ~140 students.

Teaching Assistant for Undergraduate Thermodynamics Course, UT-Austin **2007 - 2008**
As a TA for approximately 40 students, I directed 2 hours a week of recitation section where I solved problems and lectured on current course topics. I graded homework, quizzes and tests and held open office hours for 1 hour or more per week.

Teaching Assistant for Graduate Combustion Course (Instructor, Janet Ellzey) **2010**
As a volunteer TA for this course, I independently prepared and delivered all of the lectures on chemical kinetics (~8 hours of lecture) and wrote the exam questions related to chemical kinetics. I also supported the students in the use of computational modeling codes (Cantera) for their homework assignments.

PROFESSIONAL EXPERIENCE

Systems Engineer, Raytheon Company **2005 - 2007**
At the Missile Defense Center, I analyzed simulations of the Upgraded Early Warning Radar System (UEWR) for the Ballistic Missile Defense System. I worked to resolve tracking problems found in live and simulated radar data. I prepared and ran simulations for Ground-Based Missile Defense flight tests and prepared post-mission reports for Boeing and Military customers. In my role as team lead for ESP program of UEWR, I oversaw a program to develop and implement performance standards for the long-term assessment of UEWR radar operability. In my role as Test Director for a major flight test for the Forward-Based X-Band Transportable Radar, I managed a team of ~20 engineers to run and analyze test simulations while working with the US DoD, Boeing, and three other Raytheon radar programs.

Mechanical Engineer, Raytheon Company **2004 - 2005**
At a manufacturing facility, I facilitated assembly of high voltage radar power supply components by working directly with union assemblers to develop optimal assembly processes. I Wrote assembly instructions and clarified processes. I also designed many assembly fixtures using Pro/E.

AWARDS AND ACCOMPLISHMENTS

Thrust 2000 Fellowship - Cockrell School of Engineering, University of Texas at Austin, 2007 - 2011

University Continuing Fellowship - UT Austin: Two semester award of full tuition and stipend, Fall 2010 - Spring 2011

Best Paper – Given by the Advanced Energy Systems Division of ASME for the paper, “Conversion of Wet Ethanol to Syngas and Hydrogen” presented at the ASME Energy Sustainability 2008 Conference,

Innovation Grand Prize – UT-Austin GAIN Conference, April 2009

First Place – UT Austin Department of Mechanical Engineering Research Poster Contest

Travel Grant - Fire and Plasma Systems Division of the NSF for travel to 33rd International Symposium in Beijing, August 2010

Travel Grant - The Combustion Institute, March 2011

Travel Grant - The Combustion Institute, March 2010

Travel Grant - Graduate Engineering Council of UT-Austin, March 2009

Raytheon Six Sigma Certification – Raytheon Company, May 2004

COURSEWORK

Combustion Theory

2010 Summer School on Combustion (Combustion Energy Frontier Research Center at Princeton University)

Optical Diagnostics for Gas Flow

Fundamentals of Combustion Science

Reacting Flows and Plasmas

Introduction to CFD / Engineering Numerical Analysis

Radiation in Participating Media

Physics of Fluids (Cornell)

Physical Chemistry I (Cornell)

Advanced Thermodynamics (Classical)

Fundamentals of Heat and Mass Transfer

Fundamentals of Incompressible Flow

Energy Technology and Policy

Undergraduate work in philosophy

Business and Public Policy Ethics
Philosophy of Science and Modern Science
Ethical Theories
Philosophy of Mathematics and Physics
Ancient Philosophy (Cornell)
Knowledge and Reality (Cornell)

PROFESSIONAL SOCIETY MEMBERSHIP

The Combustion Institute, 2008 – Present
American Society of Mechanical Engineers, 2001 – Present
American Institute of Chemical Engineers, 2009 – Present

REFERENCES

Dr. Janet Ellzey
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