

# Ankur Kumar

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CONTACT INFORMATION 2900 Cole Street, Apt 301 +1-512-947-9611  
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WORK AREAS Mathematical Modeling, Process Control & Optimization

INDUSTRIAL **Praxair Technology Center** [May 27 - Aug 25, 2014] & [June 8 - Aug 24, 2015]

INTERNSHIPS Praxair Inc. 175 East Park Drive, Tonawanda, NY 14150, USA

*Topic: Model based Reformer Balancing for Improvement of Hydrogen Production Efficiency*

*Manager: Dr. Troy Raybold, Director, Hydrogen R&D*

*Dr. Jesus Flores-Cerrillo, Associate Director, Advanced Controls and Statistics R&D*

- Performed systematically designed experiments at a large scale hydrogen manufacturing plant
- Developed data-driven furnace (mathematical) model and mixed-integer optimization solver facilitating efficient manual control of fuel-distribution leading to reduction in furnace temperature non-uniformity and increase in overall plant energy efficiency
- Developed and deployed the second version of a user-friendly web-based ‘furnace-balancing’ interface (MATLAB, SQL Sever, Tableau, and Python based) for plant operators

**Hindustan Unilever Research Center** [May 6 - July 5, 2010]

Hindustan Unilever Ltd. 64 Main Road, Whitefield, Bengaluru, Karnataka, 560066, India

*Topic: Temperature-induced Optical Transmittance Changes of Polymer Composite Films*

*Manager: Dr. Deeleep Rout, Senior Scientist*

- Studied phase behavior of various liquid mixtures and the impact of micro properties (such size distribution of dispersed droplets) on light transmittance
- Synthesized a smart material that is transparent below  $37^{\circ}\text{C}$ , becomes opaque at elevated temperature ( $45 - 55^{\circ}\text{C}$ ) and regains transparency upon cooling (reversible transmittance reduction of 90%)

ACADEMIC **University of Alberta** [May 2011 - July 2011]

INTERNSHIP Department of Chemical Eng. 116 St. and 85 Ave. Edmonton, Alberta T6G 2R3, Canada

*Topic: Uncertainty Analysis and Risk Assessment for Geological CO<sub>2</sub> Storage*

*Guide: Prof. Vinay Prasad, Process Control Group*

- Studied dynamics of CO<sub>2</sub> sequestration in depleted oil reservoirs
- Implemented Polynomial Chaos Expansion method for efficient prediction of uncertainty in outputs such as reservoir pressure due to uncertainty in parameters like porosity; results obtained from chaos of various orders were compared with that obtained from Monte Carlo simulations

EDUCATION **University of Texas at Austin, USA**

**Ph.D.** in Chemical Engineering [Aug. 2012 - Fall 2016 (expected)]

GPA: 3.81/4.00

Thesis Topic: *Model based Operation of Industrial Steam Methane Reformers using Large Scale Sensor Data.* Advisors: Dr. Thomas F. Edgar & Dr. Michael Baldea

**Description & Accomplishments:** The project aims at developing a data-driven mathematical model of a steam-methane reformer (SMR) furnace and devising a control strategy to facilitate ‘furnace-balancing’, i.e., to reduce the non-uniformity in the furnace temperature distribution leading to energy savings.

Accomplishments till date include successful demonstration of proof-of-concept using a representative SMR CFD model, and development of a novel Egg-Crate SMR (EC-SMR) furnace model that is robust to noise in temperature measurements. Optimal sensor and actuator placement strategy has been formulated to provide a low-cost furnace optimization solution.

**Relevant Courses:** Optimal Control, Nonlinear Dynamics and Control, Stochastic System and Control, Fault Diagnosis, Optimization, Finite Element Methods, Computational Methods in Thermal Fluid Systems, Math Model of Engineered Systems, Advanced Mathematical Analysis

## Indian Institute of Technology, Bombay, India

**B.Tech.** with Honours in Chemical Engineering [July 2008 - May 2012]  
Minor in Computer Science & Engineering  
GPA: 9.25/10  
Thesis Topic: *Modeling of Formation of Food Foams during Baking*  
Advisor: *Prof. Anurag Mehra*

**Thesis Accomplishments:** Developed stochastic model for growth of non-spherical-shaped bubbles in foamy foods during baking and modeled the dynamic evolution of size distribution of ellipsoidal-shaped bubbles using multi-dimensional population balance equations. Developed the Matlab routine using the proposed algorithm and benchmarked it against the results obtained through Moving-Pivot points method for 1-D growth.

**Relevant Courses:** Modeling & Simulation, Applied Multivariate Statistics, Process Control, Digital Control, State Estimation Theory, Advanced Process Design, Advanced Reaction Engineering

### AWARDS & RECOGNITIONS

- *Best research-poster presentation* in ‘Energy Economics’ at UT Energy Week [Feb 2016]
- *2<sup>nd</sup> best research-poster presentation* in ‘Energy Efficiency’ at UT Energy Week [Feb 2015]
- Article published in *I&EC research* journal selected as *ACS Editors’ Choice* as ‘recognition of research of importance to the global scientific community’ [Jan 12, 2015]
- *Institute Silver Medal* for the best academic performance among the graduating batch of 2012 in Chemical Eng. at the Indian Institute of Technology Bombay [Aug 2012]
- *Department Special Mention* for exemplary contributions to department activities [May 2011]
- *Mitacs Scholarship* for research collaboration with Canadian researchers [Summer 2011]

### PEER-REVIEWED PUBLICATIONS / CONFERENCE PRESENTATIONS

**A. Kumar**, M. Baldea, and T. F. Edgar. “On Optimal Sensing and Actuation Design for an Industrial Scale Steam Methane Reformer Furnace”. [Submitted, March 2016]

P. Korambath, J. Wang, **A. Kumar**, B. Schott, R. Graybill, M. Baldea, and J. Davis. “A Smart Manufacturing Use Case: Furnace Temperature Balancing in Steam Methane Reforming Process via Kepler Workflows”. *Procedia Computer Science* [Submitted, Jan 2016]

**A. Kumar**, M. Baldea, and T. F. Edgar. “Reduced-Order Furnace Model for Real-Time Optimization of Industrial Steam-Methane Reformer Under Distributed Sensing”. *Control Engineering Practice*. [Submitted, Jan 2016]

**A. Kumar**, M. Baldea, T. F. Edgar, and O. Ezekoye. “Smart Manufacturing Approach for Efficient Operation of Industrial Steam-Methane Reformers”. *Ind Eng Chem Res*, 2015.

P. Korambath, J. Wang, **A. Kumar**, L. Hochstein, B. Schott, R. Graybill, M. Baldea, and J. Davis. “Deploying Kepler Workflows as Services on a Cloud Infrastructure for Smart Manufacturing”. *Procedia Computer Science*, 2014

**A. Kumar**, M. Baldea, and T. F. Edgar. “A Robust Data-Driven Reduced-Order Model for Real-Time Optimization of Steam-Methane Reformers Under Distributed Sensing”. *AIChE Annual Meeting*, 2015

**A. Kumar**, M. Baldea, and T. F. Edgar. “Distributed Control of Steam Methane Reformer Temperatures in a Smart Manufacturing Framework”. *AIChE Annual Meeting*, 2014

### SOFT SKILLS

- Programming: C++, Python, GAMS, gPROMS, MATLAB, Octave, Scilab, Excel VBA
- Softwares: Ansys Fluent, Gambit, ICMCFD, Aspen Plus, Tableau, L<sup>A</sup>T<sub>E</sub>X, Linux
- Web skills: HTML, CSS, Javascript, Django, MYSQL, MS SQL Server
- Strong (written and oral) communication skills
- Languages: English and Hindi (professional), Spanish (basic)

- INTERPERSONAL SKILLS
- Manager**, Competitions, Azeotropy [Oct. 2010 - March 2011]  
*Part of 12 member team responsible for organizing IIT Bombay's Annual Student's Chemical Engineering Symposium (budget: INR 0.6 million)*
- Led a 2-tier team of 15 members for organizing the events (participated by over 100 colleges); handled all infrastructural and logistic issues
  - Conceptualized several innovative events particularly for the freshmen and sophomores, resulting in large participation with number of registrations crossing 1500 for the first time
- Team Leader**, Design & Production, Biosynth [July 2010 - April 2011]  
*Team received the IGCW 2009 award for innovation & research in Green Technology & Engineering*
- Led the design & production team towards installation of an in-campus Biodiesel plant of capacity 200 litres at IIT Bombay
  - Trained new team members to acquaint them with process protocol and equipment designs. Conceptualized short term projects aimed at encouraging involvement of other members of Chemical Engineering department; guided and successfully supervised the completion of projects
- Mentor**, Department Academic Mentorship Program [April 2011 - April 2012]  
*Part of 11 member team concerned with addressing academic issues of underperforming students*
- Counseled 6 students: helped them identify areas of development and handle stress
  - As part of curriculum review team, contributed in carrying out a survey encompassing perspectives of faculty, students, and industry and suggested academic curriculum modifications
- OTHER INTERESTS      Reading fiction/non-fiction novels; Playing guitar; Traveling