Chemical Engineering Interface '12

Remembering
Herbert L. Toor
Dear Alumni and Friends,

It has been two years since we last published our Alumni Newsletter and so there is a lot of catching up to do. While we were remiss in failing to publish last year, it was not for lack of news. More to the point, we have been too busy making news. I hope that you have an opportunity to peruse the following pages and to acquaint yourself with the developments in Chemical Engineering at Carnegie Mellon.

The department as a whole has been doing very well over the past two years. At last publishing, we had just finished the renovations to Doherty Hall and the creation of modern laboratory and research facilities. These continue to serve us very well and we are still very proud of our shared laboratory model in which multiple groups working in similar research areas work side-by-side, sharing equipment and collaborating seamlessly. In particular, this model is very attractive to the graduate students who certainly reap the greatest benefit. A more recent and equally exciting development has been the inclusion of Chemical Engineering at Carnegie Mellon among a select group of eleven departments chosen to participate in a long term research partnership with Dow Chemical Corp. We are honored to participate and very pleased to see that our research strengths are being recognized and valued by our industrial partners.

The faculty are thriving and representing Carnegie Mellon to a global audience through their travels and other professional activities. My colleagues have received numerous awards and accolades for their research as highlighted in subsequent pages. We continue to strengthen the department through the additions of two faculty: Dr. Jeff Sirola and Dr. Aditya Khair. We are also in the process of extending four additional offers to junior faculty in various areas, and I hope that we can introduce them to you in the next edition of this Newsletter. Unfortunately, we have also lost one of the most influential members of our department. It is with great sadness that we announce the loss of Herb Toor who died in July. Herb’s legend was remembered by his colleagues, the entire College of Engineering, and many other members of the university community at a memorial service held on campus in February hosted by Dean Pradeep Khosla.

Finally, I want to remind you that the 2012 Annual AIChE meeting is being held in Pittsburgh from October 28 – November 2. We invite all of our alumni to join us on campus the evening of Sunday, October 28th for a reception and dinner so please save the date. We would like to show off our newly renovated space in Doherty Hall with tours, and ask our former PhD students to sign the “new” walls in the graduate lounge. In addition to this Sunday evening event, the department will also host its traditional reception at the meeting itself on Monday evening. We are very much looking forward to seeing you at both.
Dr. Jeffrey J. Siirola, past President of AIChE and member of the National Academy of Engineering, has joined the Departments of Chemical Engineering and Engineering and Public Policy at Carnegie Mellon as Distinguished Service Professor of Sustainable Energy Systems. Jeff will be involved in teaching Chemical Process Systems Design, Chemical Product Design and Junior Seminar courses. He will also be involved in the energy, sustainability and carbon capture research activities of the Center for Advanced Process Decision-making (CAPD), the National Energy Technology Laboratory – Regional University Alliance (NETL-RUA) and the Department of Engineering and Public Policy. He will also advise the College of Engineering programs on Advanced Manufacturing Partnership and Innovation in the Curriculum.

Dr. Aditya Khair joined the Department of Chemical Engineering in August 2010 as Assistant Professor. Rather than “joined” we should perhaps say “re-joined,” since he was previously an exchange student at CMU in 1999-2000 from Imperial College London where he received his MEng in Chemical Engineering in 2001. Aditya received his PhD in Chemical Engineering from Caltech in 2007 and then spent two years as a post-doc at UC Santa Barbara. Aditya is broadly interested in all aspects of small-scale fluid dynamics and transport, with a current focus on electrokinetic phenomena, micro- and nano-fluidics, rheology, and colloidal physics. His approach is primarily theoretical — scaling, asymptotics, and numerics — although he does hope to incorporate an experimental component into his research program eventually.
Professor Shelley Anna has been active in leadership roles in her professional societies. She was elected Vice Chair of the Gordon Research Conference on Physics & Chemistry of Microfluidics for 2013 and Chair for 2015. She served as the Meeting Program Coordinator for the Fundamentals in Fluid Mechanics Area at the AIChE Annual Meeting in Salt Lake City in 2010, and she was subsequently elected Vice Chair for the Area for 2010-2012, and Chair for 2012-2014. She was also elected as Member-At-Large on the Executive Committee of the Society of Rheology. Professor Anna taught a short course on Microfluidics for the 13th European School on Rheology in Leuven, Belgium in September 2011. As part of a consortium with Tulane University funded by the Gulf of Mexico Research Initiative, she and Professor Lynn Walker were awarded funds to study the science and technology of dispersants used for deep-sea oil releases. Finally, in November 2011, Shelley was awarded the Russel V. Trader Career Faculty Fellowship in Mechanical Engineering, in which she holds a joint faculty appointment. In 2012, Shelley was awarded Honorable Mention for a Carnegie Science Award in the category of Emerging Female Scientist.

Professor Larry Biegler gave a keynote presentation, entitled “Integrated Optimization for Advanced Energy Processes” at the European Congress of Chemical Engineering in Berlin and a seminar entitled “Multi-Scale Optimization for Advanced Energy Systems” at the University of Florida. He also presented three papers at the 18th IFAC World Congress in Milan as well as 11 papers at the 2011 Annual AIChE Meeting in Minneapolis. He then received the Nordic Process Control Award in January, 2012. Recipients of this award “have made a lasting and significant contribution to the field of process control”. Larry also published the book: Nonlinear Programming: Concepts, Algorithms, and Applications to Chemical Processes in 2010. Lastly, Larry has been appointed University Professor, the highest academic rank at Carnegie Mellon.

Professor Kris Dahl was awarded the NSF CAREER Award for her research on “Genome Regulation and Nuclear Rheology.” This is a prestigious five-year grant that accelerates the progress of young faculty in their professions. The subject of the research funded by this award will be the origin of gene expression. The sequencing of the human genome...
was a major achievement, but poor understanding of the mechanisms controlling gene expression limits the usefulness of this information. The hypothesis of Kris’ CAREER proposal is that subjecting to mechanical force causes reorganization of the nucleus that helps regulate gene expression. The role of force in regulating gene expression is an emerging and uniquely multi-disciplinary area of study. Mechanical force is important both for organism development and for maintenance of cells and tissues. Nuclear deformation is believed to be important because placement of genes within the nucleus is correlated with their expression. The aim, therefore, is to establish a link between mechanical force such as shear stress and gene expression.

**Professor Mike Domach** serves on the Scientific Advisory Board of a new Engineering Research Center at Rice University, the CBiRC (NSF Center for Biorenewable Chemicals), the Chemical Engineering Advisory Board at the University of Michigan and the Society of Biological Engineers (SBE) advisory board. SBE is an AIChE Technological Community which is a global organization of leading engineers and scientists dedicated to advancing the integration of biology with engineering. Recently, Mike assumed the role of Editor-in-Chief of Biotechnology Progress, the official journal of the Society for Biological Engineering. In addition to an active NSF grant that now supports Mike’s work on DNA vaccine engineering, Lynn Walker and Mike were awarded an NSF grant to explore the potential of nano-templated materials for the long term storage of therapeutic antibodies. Last, but certainly not least, the annual fishing trip that was organized and energized by the late Gary Powers continues. This year, Mike led the cohort to New Mexico where the San Juan River was fished, and many fine trout were caught and released.

**Professor Neil Donahue** has delivered a series of plenary and keynote talks at international meetings on the atmospheric chemistry of hydrocarbons and the chemistry of organic particulate matter. This includes plenary lectures at the International Gas Kinetics Meeting in Leuven, Belgium in July 2010, a keynote lecture at the Goldschmidt Geochemistry Conference in Prague, Czech Republic in August 2011, and a plenary talk at the 2011 national meeting of the American Chemical Society in Denver, Colorado in September 2011. He has also been serving on the review committee developing new air toxics guidelines for Allegheny County.

**Professor Andy Gellman** has been appointed to be an editor of the journal “Catalysis Letters” and has been serving in that role for the past year. In December 2010, he served on the review committee for the Department of Chemical Engineering and Applied Chemistry at the University of Toronto. During 2010-2011, Andy was invited to give lectures at universities and international conferences in Germany, Japan, Brazil, England, and South Korea. He traveled to Germany and Brazil to give invited lectures at the San Luis V conference and Ash Wednesday Discussions. The San Luis V is the fifth in a series of symposia targeted to unite Latin American and US and European scientists in the area of surface science and catalysis. Recently, he returned from a trip to Korea during which he spoke at eight universities and research institutes. In September, he was asked to give the Inaugural First Energy Lecture at the University of Akron. In 2011, Andy was elected a Fellow of the American Chemical Society.
Professor Ignacio Grossmann was named recipient of the 2011 Research Excellence in Sustainable Engineering Award from AIChE, which he received at the Annual AIChE Meeting in Minneapolis. In January 2011, he participated in the 9th US-Mexico Workshop on Optimization and Applications in Oaxaca, Mexico. He then traveled to Europe at the end of January and visited Imperial College, ETH-Zurich, RWTH-Aachen, Eindhoven, Unilever and Technical University in Berlin, where he gave a number of seminars, and met with CMU students who are in the exchange program with Imperial College and RWTH-Aachen. He also gave a seminar at Georgia Tech. He subsequently went to Argentina where he taught a one-week short course at Santa Fe and also visited PLAPIQUI in Bahia Blanca where he gave two seminars. He also visited Dalian University of Technology in China, and spent 4 weeks in Spain where he visited the University of Rovira i Virgili in Tarragona. He attended the ESCAPE-21 meeting in Chaididiki, Greece, where he gave the plenary lecture. He also attended the Pan American Advanced Study Institute on Process Systems Engineering in Angra do Reis, Brazil. He then gave a seminar at the Department of Industrial Engineering, Pontificia Universidade Católica, Rio de Janeiro, Brazil. Ignacio gave two seminars in the Department of Chemical Engineering, University of Maribor, Slovenia. He also attended the Annual AIChE Meeting in Minneapolis presenting a total of 12 papers. Ignacio has also been active at the NAE, and attended the chemical engineering advisory board meetings at Penn State and Purdue in March and April, respectively. An important milestone is that Ignacio recently exceeded the mark of 10,000 citations to his published work with an h-index of 56.

Professor Annette Jacobson was appointed Associate Dean for Undergraduate Studies for Carnegie Institute of Technology (CIT) effective February, 2010. Annette’s responsibilities include undergraduate education, advising, first year programming, accreditation and outreach programs within the college. In this capacity, she works with undergraduates in the first year as well as upperclassmen, faculty and staff in all CIT departments.

Professor Myung Jhon was on leave of absence during the Fall Semester at the School of Advanced Materials Science & Engineering at Sung Kyun Kwan University in South Korea participating in the World Class Research-Oriented University Program administrated by Korean Ministry of Education, Science & Technology. This program aims to establish global graduate programs through collaboration between Korean faculty members and world-renowned international scholars. Myung has constructed a very large computational facility at SKKU which has the capability of performing intensive multi-scale simulations of extremely large systems. Through this facility, he has been involved with several key nano-convergent technologies that are critically important to next-generation human interface systems including direct printing for flexible electronics, organic light-emitting devices, and remanufacturing, via the development of novel materials including graphene and carbon nanotube, multi-scale modeling, unit devices, and system integration. He organized the U.S.-Korea forum on nanotechnology for sustainability at Caltech, and served as a guest editor for the special issue of
Professor Aditya Khair gave invited talks at workshops on Chemi-Thermo-EM Phoresis in Complex Fluids, at POSTECH in Pohang, Korea in August 2010, and on Electrokinetic Phenomena in Nano-colloids and Nano-fluidics in December 2010 at the Technion in Haifa, Israel. He also gave invited talks at two research conferences: the APS Division of Fluid Dynamics Annual Meeting in Baltimore MD in November 2011 and at the Gordon Research Conference on Colloidal, Macromolecular, and Polyelectrolyte Solutions, in Ventura, CA in February 2012. Aditya is the meeting organizer for the American Electrophoresis Society Annual Meeting (held in conjunction with the AIChE annual meeting) for 2012, in Pittsburgh PA.

Professor John Kitchin was awarded $750,000 from the U.S. Department of Energy for development of new materials for electrochemical production of hydrogen and oxygen from water. John is one of 69 researchers nationwide to receive funding as part of the Department of Energy Early Career Research Program. The new effort is designed to bolster the nation’s scientific workforce by providing support to exceptional researchers during their crucial early career years, when many scientists do their most formative work. John’s research is intended to give the nation’s hydrogen economy a jumpstart. The research is designed to make hydrogen production from water more efficient which will, ultimately, enable the development of future energy systems to store intermittent renewable energy in chemical form and to make better use of biomass to fuel everything from cars to large turbines and factories. In addition, the oxygen produced from this process may play a crucial role in helping to manage the CO₂ emissions through advanced fossil energy power systems such as oxycombustion and gasification. More recently, John gave the 2011 Allan P. Colburn Memorial Lectureship in the Department of Chemical Engineering at the University of Delaware.

Professor Jim Miller was recently recognized by AIChE as one of its best assets in the Pittsburgh area. Jim won a Shining Star - AIChE Volunteer of the Year Award. Each year, AIChE recognizes volunteers who have gone above and beyond the normal duties of leadership. The Local Section Committee and the Career and Education Operating Council created the Shining Star award to recognize such individuals. AIChE solicited nominations from all Local Section officials. The AIChE-Pittsburgh leadership team nominated Jim for his work as Local Section Vice-Chair (2006-2007), Chair (2007-2008), Newsletter Editor (2008-2009), and Counselor (2011-). In our department, Jim is faculty advisor to the student AIChE chapter and the award-winning ChemE Car team. Over the past year Jim served as lead organizer of both a symposium on “Combinatorial and High-Throughput Methods in Materials Science” at the Fall 2011 meeting of the Materials Research Society (with Andy Gellman) and a symposium on “High-Throughput Approaches to Catalyst Discovery and Optimization” at the Spring 2012 ACS meeting.
Professor Spyros Pandis received the 2011 European Research Council IDEAS award. These are given on the basis of past excellence to support research of the very highest quality at the frontiers of knowledge in Europe. The award is accompanied by approximately 2.5 million Euros (3.5 million dollars) to support research in the area of atmospheric particulate matter and its role on air quality and climate change. This will be a collaborative effort between Spyros’ research group in Greece and the Center for Atmospheric Particle Studies at CMU. A rapidly emerging challenge for society is to tackle air pollution and climate change in a common policy framework. To address this research problem Spyros together with the CAPS faculty and students are coordinating a European/US integrated project called PEGASOS to better quantify the regional and global links between air pollution and climate change and to underpin mitigation options and other policy initiatives. One of the innovative aspects of this study, involving approximately 30 research groups from 18 countries, is the use for the first time of a Zeppelin (shown below) as a measurement platform.

Professor Dennis Prieve received the 2011 ACS Award in Colloid & Surface Chemistry on March 29th, 2011 during the spring National Meeting of the American Chemical Society in Anaheim, CA. This award is given annually to “recognize and encourage outstanding scientific contributions to colloid and/or surface chemistry in North America." Dennis is cited for his “invention of Total Internal Reflection Microscopy for measuring weak colloidal interactions and studying Brownian motion in confinement.” TIRM can detect nanometer changes in location of a microscopic sphere, levitated above a plate in a viscous liquid. From the equilibrium distribution of elevations, the (sub-piconewton) force on the sphere can also be determined. Many of Dennis’ former students presented talks on March 29th at two half-day sessions in his honor organized by Prof. Darsh Wasan, Prof. Robert Ofoli and John Anderson (past head of CHE and Dean of CIT at CMU and now President of the Illinois Institute of Technology).
Professor Todd Przybycien has been elected a fellow of the AIChE in recognition of his professional attainment and significant accomplishment in chemical engineering. Also, Todd has been elected to a three-year term on the managing board of AIChE’s Society for Biological Engineering. In 2010, Todd was named a co-chair of the Recovery of Biological Products XV Conference. This biannual conference will be held in Stowe, VT in August, 2012 and is the premier international conference in the area of downstream bioprocessing. In September 2011, Todd co-chaired the 16th BioPartitioning and Purification Conference held in Puerto Vallarta, Mexico.

Professor Nick Sahinidis received the Computing in Chemical Engineering Award at the annual AIChE meeting. Nick’s term as Chair of the INFORMS Optimization Society came to an end in 2010. Nick is actively engaged in co-organizing FOCAP0 2012. Over the past year, Nick gave invited seminars at the Fields Institute in Toronto, the GERAD research center in Montreal, and the Rutgers Business School. He also gave a plenary talk at Optimization 2011 in Lisbon, Portugal. It has now been a little over four years since Nick moved to Carnegie Mellon from the University of Illinois. Two of his first CMU graduate students completed their doctoral degrees this past summer. His research program is currently funded by three DOE contracts and three NSF grants, and involves activities in risk assessment in CO₂ sequestration, molecular design, and the development of simulation-based optimization algorithms.

Professor Jim Schneider’s group continues the development of rapid, gel-free methods to separate DNA in medical devices. These methods take advantage of natural fluctuations in micelle size to achieve ultra-high resolution peaks, enabling analyses that are 10-100 times faster than commercial, gel-based systems. Jim was invited to present these results at PittCon and Pacificchem meetings focused on analytical separations. His group has also joined the nascent, interdisciplinary Center for Nucleic Acid Science and Technology (CNAST) at CMU, whose goal is to use synthetic nucleic acids for a wide range of medical applications. Jim’s group is working with other CNAST faculty to develop new means to detect microRNA levels in tissue samples with high speed and sensitivity. These recently discovered, short nucleic acids are believed to be key biomarkers for cancer and other diseases. CNAST recently received a $3.9 million grant from the David Scaife Foundation to support its work.

Professor Paul Sides had a paper that he co-authored with Professor Prieve titled “The Imaging Ammeter” featured on the cover of the Journal of Colloid Science. This work was the basis of a grant from the National Science Foundation to explore the use of colloidal particles as probes in high throughput electrochemical research. Paul gave an invited seminar at the Colorado School of Mines in October 2011. The ZetaSpin, invented by Paul and his student James Hoggard, is now in use at six sites other than at CMU: Clarkson, NIST, PPG, Virginia Tech, Dow Microelectronics, and Applied Materials. Recent research for Intel has broadened the application of the ZetaSpin from planar samples to adsorption of nanoparticles and to porous materials.
Professor Bob Tilton was named a Fellow of the American Chemical Society in August 2010. ACS Fellows are recognized “for outstanding achievements in, and contributions to, Science, the Profession, and the Society.” Bob and Kris Matyjaszewski (Professor of Chemistry and Chemical Engineering by courtesy) were the first two Carnegie Mellon faculty to be named ACS Fellows. Bob was recognized for his research in complex fluid interfacial phenomena and his service in numerous volunteer, appointed and elected roles in the ACS Division of Colloid and Surface Chemistry, including service as Division Chair. He is currently serving a three year elected term as an ACS Councilor representing the Division of Colloid and Surface Chemistry. Bob and his family spent the spring and summer of 2011 in Stockholm for a sabbatical at the Royal Institute of Technology (KTH) Division of Surface and Corrosion Science. Together with his long-time collaborator Per Claesson, Bob worked to map the mechanical heterogeneity of individual polymer-grafted nanoparticles and to investigate their adsorption and assembly behaviors at both rigid and soft interfaces. While in Sweden, Bob gave invited seminars at KTH, the Stockholm University Department of Materials and Environmental Chemistry, and the Uppsala University Department of Pharmaceutical Physical Chemistry.

Professor Lynn Walker’s work on protein and particle templating in nanostructured hydrogels has been presented in several invited lectures at the ACS national meeting and several universities. Recent funds from the NSF were received through collaboration with Mike Domach to investigate the potential for protein protection. New funding from Dow with colleagues from the Center for Complex Fluids Engineering (CFE) will develop microfluidic platforms for characterization of colloidal stability in non-aqueous media. Funding from the Gulf Research Initiative with Shelley Anna is allowing Lynn’s group to quantify dispersant adsorption on oil-water interfaces. Finally, in a collaboration with Aditya Khair her research group is also studying the impact of non-Newtonian fluids on electrokinetic phenomena.

Professor Erik Ydstie gave invited seminars on “Thermodynamics and Process Control” in the Chemical Engineering Department at Imperial College and the Electrical Engineering Department at Norwegian University of Science and Technology. He presented his one-week short course on adaptive control systems in the Mathematics Department at the University of Vigo in Spain and in the Department of Engineering Cybernetics at the University of Trondheim. He delivered a CAST plenary lecture at the AIChE Meeting in Minneapolis in November and an invited talk at the CPC-8 conference in Savannah. His research group is now addressing problems in the area of solar cells, DNA separation, plant wide control and automation. Erik’s company ILS Inc. received an NSF SBIR Phase I grant to commercialize a new wafer process for solar cells.
The 2012 Chemical Engineering Graduate Student Association Symposium will be held on Thursday and Friday, September 20 and 21, 2012. The keynote speaker will be Dr. George Stephanopoulos, the A.D. Little Professor of Chemical Engineering at the Massachusetts Institute of Technology. If you haven’t been in a while (or have never come), the Symposium showcases the PhD research projects of our more senior graduate students and is sponsored through grants from industry. During the 2-day symposium, 25-30 students will present their research to an audience of peers, faculty and industrial representatives. Along with the technical presentations, there is also a poster session where an additional 15-20 students present their work. A luncheon and wine-and-cheese reception are also held for the presenting students, faculty, and industrial sponsors in attendance. This is a great opportunity to see what our students are working on, and to re-connect with the department. Please come join us. We’d love to see you there!

2011 Symposium Award Winners

PARFITTT AWARD FOR BEST TECHNICAL PRESENTATION: Benjamin Murphy
SYMPOSIUM AWARDS: Kaytlin M Henry, Stephen Istivan
HONORABLE MENTION: Anthony Kotula, Apurva Samudra
GARY POWERS POSTER AWARD: Satyajith Amaran

Dolores Dlugokecki has retired after being a member of the Chemical Engineering staff for 44 years. Dolores started her career as a technical secretary/ transcriptionist, a position in which she typed all of the department’s manuscripts and proposals. She began her career with a typewriter and onion skin paper, and retired using a computer, pdfs and web applications. Dolores received the 2006 CIT Staff Recognition Award. This award is presented each year to an exemplary CIT staff member. The nominee is judged on several categories including commitment, attitude, dedication. Dolores’ colleagues had these things to say about her: “tremendously loyal to Carnegie Mellon”; “of all the staff members I have interacted with at CMU no one exceeds (her) capacity, capability and zeal for getting the job done”; “practically the symbol of the living history of the department.” Dolores and her family celebrated her retirement with the Chemical Engineering department at the Holiday Party.

Pictured left, Front Row: Department Head Andy Gellman, Dolores Dlugokecki, Janet Latini, Back Row: Audrey Terrel, Toni McIltrot, Alice Yochum, & Cindy Vicker at the Departmental Holiday Party
Professor Herbert Lawrence Toor, affectionately known as “Herb,” a true Carnegie Mellon legend and recognized as one of the top academic leaders in chemical engineering, died of Alzheimer’s disease in Middlebury, VT on Friday, July 15, 2011. Herb was born June 22, 1927, in Philadelphia, PA, to Matthew and Jean Mogul Toor. He grew up in Philadelphia and enlisted in the Navy at 17. He was discharged as a seaman first class shortly after the end of World War II. He obtained a BS degree in Chemical Engineering at Drexel in 1948, and an MS and PhD at Northwestern, finishing in 1952. In 1950 while at Northwestern, he married fellow graduate student of Chemistry, Elizabeth M. Weir (“Beth”) of Edmonton, Canada.

Herb became Assistant Professor of Chemical Engineering at Carnegie Tech in 1953. He was promoted to Associate Professor in 1957 and to Full Professor in 1961. In 1962, sponsored by UNESCO, he and his family spent a sabbatical year in Madras, India, to help establish a graduate program at what is now the prestigious IIT Chennai. Herb became Head of the Department of Chemical Engineering in 1967 and was appointed Dean of the Carnegie Institute of Technology in 1970, a position that he occupied until 1979. In 1980 he became the first Mobay Professor of Chemical Engineering (today the Bayer Professorship). In 1991, he and his wife Beth spent another sabbatical at the University of Sydney in Australia.

Herb Toor was a leader in transport phenomena, an area in which he modeled complex processes involving mass transfer and chemical reactions. He addressed problems of mass transfer at interfaces, multicomponent mass transfer, chemical reactions in turbulent flow, and heat transfer in particulate systems. He and his students wrote 70 publications for various chemical engineering journals.


In recognition of his early contributions to research, the AIChE awarded Herb the Alan B. Colburn Award in 1964. This award was, and still is, presented to a member of AIChE less than 36 years of age for significant contributions through chemical engineering publications. In 1990, Herb was elected to the National Academy of Engineering for “research contributions in mass transfer and chemical reaction engineering, and for advancing innovative programs in engineering and public policy and engineering design.” On occasion of the Centenary of the AIChE in 2008, Herb was named as one of the “One Hundred Engineers of the Modern Era” for his outstanding contributions in chemical engineering. He was also a Fellow of the AIChE and of the AAAS.

As a teacher Herb was legendary in the classroom. In one famous anecdote he used his cigarette rather than his chalk to write on the board. Quotes from some of his former students are as follows:

“I remember Herb could say to a few graduate students in the hall...”Let me show you something” and an impromptu 20 to 40 minute mini-lecture would follow. These were always riveting, and I remember some of them to this day. He was a true leader and communicator.” Dale Schruben, PhD ChE ’73

“Having been a chemical engineering student during Dr. Toor’s tenure as Head of the ChE Department, I have many fond memories of him. I especially remember his response when asked how long it took him to work through the four problems on a three hour final in Transport Processes. Dr. Toor admitted that it took him around six hours to work through the problems. When then asked why he would give such a difficult exam, he said that occasionally he would have a student who could actually have finished the exam. He wanted to be able to identify brilliance at that level. To a certain extent, that is what the old Carnegie Tech was about. Identifying brilliance.” F. Denis d’Ambrosi, ChE ’69
As Dean of Engineering (Carnegie Institute of Technology) Herb was probably one of the most influential deans in the history of the college. As stated by Pradeep Khosla, current Dean of CIT, “His impact is a lasting legacy for the college and the university.” Herb had a truly huge impact through two outstanding contributions. The first was the establishment of the Department of Engineering and Public Policy in 1976, a truly unique multidisciplinary educational research entity. This program combined elements of engineering analysis and design with issues related to public policy, today offering double major degrees to all engineering students. Granger Morgan, who has been head of EPP for over 35 years, stated “Herb was a wonderful guy who had enormous impact for the good of Carnegie Mellon, our engineering school and all of us who worked with him. Without his leadership our EPP department would not exist and there would be far fewer women in the world with CIT degrees.”

Inspired by the work on the sciences of artificial intelligence by the late Nobel Prize winner Herb Simon, the second major contribution made by Herb was the establishment of the Design Research Center, also in 1976. This was also a unique research program aimed at developing systematic, computational approaches to engineering design, which at the time was still very much regarded as an art. Herb hired Steve Director from Florida into ECE, Steve Fenves from Illinois into CEE, and Gary Powers from MIT and Art Westerberg from Florida into ChE. All were recognized giants, who initiated groundbreaking research in design, creating at the time a new research paradigm in engineering that continues to this day. This pioneering effort also led to the establishment by the NSF of the Engineering Design Research Center in 1986. After the 11 years of NSF funding that center became what is now the very successful Institute of Complex Engineered Systems.

Last but not least, as Dean, Herb was also particularly proud of increasing the numbers of women and minority students in the college. This remained a key goal of his throughout his career.

Herb’s main interests were his work, his family and his garden, although he also had a keen interest in history, politics and energy problems. As for his gardening, he often said that perhaps the most useful thing he had done in his life was “turning a Pittsburgh clay backyard into great soil for growing vegetables through forty years of composting.” By his own account, some of Herb’s happiest times were family camping and backpacking trips in the U.S. and the Canadian Rockies and sailing and snorkeling trips over spring break in the Caribbean or the Yucatan.

Herb is survived by his wife of 60 years, Beth Toor of Middlebury, VT; his sister, Marlene Wenograd of West Hartford, CT; his daughter, Helen Toor of Charlotte; VT, and his sons and daughters-in-law, John and Margaret Kiernan Toor of Palo Alto, CA and Will Toor and Mariella Colvin of Boulder, CO; his grandchildren, Milo, Maren, Nicky and Tera Toor and Cead Kiernan; as well as many cousins, nieces, nephews and great-nieces and great-nephews.

Herb Toor was a true giant in the field of chemical engineering, a CIT Dean that left a huge and lasting contribution to the College of Engineering, and a tough but also very kind and caring man. He is sorely missed by his family and by the alumni and his colleagues in ChE and at CMU.

To honor Herb’s memory and the particularly high value that he placed on encouraging women in engineering, the Department of Chemical Engineering at Carnegie Mellon is creating an endowment for the Herb Toor Fellowship for women in its PhD program. It is interesting to note that at the outset of Herb’s career, the department had virtually no women in its undergraduate class. Today, the class of 2015 (current freshman) has 47% women. By comparison, the PhD program has ~25% women. The next challenge is clear and by establishment of the Herb Toor Fellowship we hope to continue his effort to bring our discipline to gender parity.
In Memory of Edmond I. Ko

As this edition was going to press, we learned that Professor Edmond I. Ko passed away on April 20, 2012, in Hong Kong at the age of 60. Ed began his career at Carnegie Mellon as an assistant professor in Chemical Engineering in 1980 after earning his doctorate in Chemical Engineering at Stanford. Ed has published more than 100 articles in the area of surface science & catalysis & has a US patent: “Hydrodesulfurization and Hydrodenitrogenation over a Transition Metal Oxide Aerogel Catalyst.” Among Ed’s many awards is the William H. and Frances S. Ryan Teaching award at Carnegie Mellon in 1986. He was passionate about education and became the Vice Provost for Education at Carnegie Mellon in 1996. He left Carnegie Mellon & returned to Hong Kong where he was the Vice- President (Undergraduate Education), Dean of Students, and Professor (Chair) of Chemistry at City University of Hong Kong (CityU). Ed then became the Director of the Center for Engineering Education Innovation and Adjunct Professor of Chemical Engineering at The Hong Kong University of Science and Technology (HKUST).

Doherty Hall Phase II Wins MBA Building Excellence Award

On February 24, 2011, at the Master Builders Association (MBA) of Western Pennsylvania 2011 Construction Evening of Excellence, it was announced that the Doherty Hall Phase II Renovation Project was the winner of the Building Excellence Award for Renovation Construction Over $10 Million. This award is considered the highest and most coveted commercial construction industry award in Western Pennsylvania. While many projects were submitted for consideration, Doherty Hall Phase II and Bakery Square, the renovation of the old Nabisco plant on Penn Ave., were the finalists.

Judged by a panel of industry experts, the MBA Building Excellence Award honors the entire Project Team including the general contractor, owner, architect, engineer, and craftspeople, who work together to assure a successful project. Judging was based on the following criteria: Design and Craftsmanship, Project Teamwork, Innovation, Meeting Difficult Challenges, Client Satisfaction, and the Integration of Green Building Practices. Doherty Hall Phase II involved the renovation of the entire Chemical Engineering Department Laboratory and Office spaces as well as renovations in the Physics and Art Departments. The award was presented to Jendoco Construction Corporation, the general contractor for the project. Michael Kuhn, Jendoco Vice President, praised the collaborative spirit of the Project Team which he said allowed the Project to excel in every aspect of the award criteria.

This is the second local award for the Doherty Hall Phase II Project. In 2009, the Pittsburgh Historic Review Commission awarded the Project and Jendoco a “Preservation Award” for what it termed the “sympathetic” renovation of Doherty Hall. Built in 1908 as one of the original buildings of Andrew Carnegie’s Carnegie Technical School, it is designated a Historic Landmark by the Pittsburgh History and Landmarks Foundation. During the renovation, special care was taken to preserve as many of Hornbostle’s original architectural features as possible, including interior and exterior windows and woodwork, curved ceilings, and the Hornbostle stairs at the back of the wing. The original roof trusses were left in place and are partially exposed in the ceiling of the Complex Fluids Engineering Laboratory on the third floor.

The Green Building Practices followed during the project were evaluated and Doherty Hall Phase II was certified with a LEED Silver rating, a rarity for projects involving laboratory renovations in historic buildings. The Leadership in Energy and Environmental Design (LEED) rating system is certified by the US Green Building Council.
AICHE Annual Meeting 2012 will be in Pittsburgh.

Save the date! We invite all of our alumni to join us on campus the evening of Sunday, October 28th for a reception and dinner so please save the date. We would like to show off our newly renovated space in Doherty Hall with tours, and ask our former PhD students to sign the “new” walls in the graduate lounge. In addition to this Sunday evening event, the department will also host its traditional reception at the meeting itself on Monday evening.

Dow Chemical Partners with ChE at CMU

Dow Chemical Corp. has chosen the Department of Chemical Engineering at Carnegie Mellon as one of 11 departments nationwide with which it is partnering to strengthen research in traditional scientific fields important to Dow and the nation’s future. Dow announced its investment in programs with leading U.S. universities through a $25 million per year commitment for 10 years. Needless to say, the department is extremely excited and honored to be recognized among this select group of universities.

Chemical Engineering at Carnegie Mellon was chosen for its excellence in science and engineering education, its excellence in research, and its willingness to collaborate with industry. Each university partnership has been designed to build off of the unique strengths of the department; in our case strengths in process systems engineering and in complex fluids engineering. Dow’s investment will support faculty, students and infrastructure, enabling a critical mass of resources to address some of the world’s leading challenges.

The partnership is supporting six projects within the Process Systems Engineering group:

1. Development, Implementation, and Application of a Molecular Design Framework
2. Optimization-based Development of Polymer Products
3. Automation Systems for Complex Chemical Processes
4. Planning Optimization of Reliable Product Envelopes
5. Financial Risk Optimization over Discrete Event Simulators
6. Verification of Controller Logic for Complex Automation Systems

These are being led by Professors Sahinidis, Grossmann, Biegler and Ydstie.

The partnership also supports two projects within the Complex Fluids Engineering group.

1. Electrostatics in Organic Media
2. Characterization techniques for Stability in Organic Media

These projects are being led by Professors Walker, Prieve, Sides, Khair and Anna.

Process Systems Engineering and Complex Fluids Engineering have been traditional strengths of Chemical Engineering at Carnegie Mellon for decades. Dow’s investment reflects the critical importance of these core chemical engineering disciplines.
Charges, Particles, Flows and Fields

We are surrounded by materials and fluids in which there are charged particles of all sizes moving under the influences of various forces. Understanding the motion of such particles is critical to predicting the properties of these materials and to the design of new fluids or fluidic processes with predetermined properties. This is the realm of the research conducted by Professor Aditya Khair and his students. Their philosophy is to develop an understanding of a phenomenon at a fundamental level, with the ultimate goal of leveraging that knowledge for novel applications.

For example, Professor Khair is investigating the dynamics of charged colloidal particles under strong gravitational or electric fields. The gravitational case is relevant to ultracentrifugation and “streaming flows” in microfluidic devices, and the electrostatic case to electrophoresis in non-polar solvents. In solution, charged colloidal particles are surrounded by a cloud of counter ion, screening charge. The vast majority of current understanding applies only to weak fields that only slightly perturb the nanoscale ionic screening cloud surrounding the charged colloid. In contrast, for strong fields the screening cloud can be significantly distorted (figure 1). This has a huge impact on the colloid’s sedimentation rate or electrophoretic velocity as the field strength is increased. Describing the distribution or shape of the highly distorted, non-equilibrium screening-cloud is extremely challenging but critical to the ability to predict particle velocity under the influence of the field.

Khair’s work is also focused on the interplay of electric fields and complex (non-Newtonian) fluids. Complex fluids: e.g. colloidal dispersions, polymer solutions, and biofluids are ubiquitous. While much is understood about their dynamics under hydrodynamic flows, comparatively little is known about electrokinetic phenomena (e.g. electro-osmosis and electrophoresis) of complex fluids driven by electric fields. This is startling, given that electric fields are routinely used to drive transport in complex fluids in microfluidic devices. Khair’s challenge is to identify and quantify electrokinetic effects in complex fluids. His work suggests novel consequences of non-Newtonian rheology, including non-linear, temporally complex electro-osmotic flows; explicit dependence of electrophoretic velocity on particle size and shape; and rheology-mediated electrokinetic particle interactions. These effects are absent in Newtonian fluids, illustrating the dramatic influence of non-Newtonian rheology on electrokinetic phenomena.

Khair is also interested in liquid- and solid-state electrochemical systems. In the liquid state, he has shown that fluid flows can be used to tune ionic concentration gradients and instabilities at charge-selective surfaces, such as ion-exchange membranes or nanochannel arrays. In solid-state electrochemical systems, he is describing charge transport in solid-state lighting devices. For example, in an organic light emitting diode, charge carriers (electrons and holes) are injected into an organic semiconductor film at opposing electrodes and must move through the film to recombine and generate light. Khair’s work asks where the recombination zone located within the film is. How does current and light emission vary with voltage? Existing computational tools developed originally for inorganic, semiconductor lighting devices cannot adequately address these issues in organic films, due to their inability to resolve the rapid variations in carrier concentration inherent to organic devices (resulting from nonlinear recombination kinetics and strong diffusion currents). Khair is tackling these problems using methods originally developed for study of liquid phase phenomena.
The departmental structure of most US universities developed around their pedagogical mission and its disciplinary structure. For example, the College of Engineering at CMU has seven departments (Chemical Engineering, Electrical and Computer Engineering, Biomedical Engineering, Mechanical Engineering, Materials Science and Engineering, Civil and Environmental Engineering, and Engineering and Public Policy). Each has its curriculum that has been developed over decades, and has roots in specific areas of science and technology. From the point of view of educating students or the dissemination of knowledge, this structure serves its purpose well. Historically, the research mission: the creation of knowledge, has also been pigeon-holed into the same structure. However, this serves little purpose because the creation of knowledge should not be bound by structures based on existing knowledge. To foster interdisciplinary research activity, CMU has numerous research centers. These are housed for administrative purposes in individual departments but can involve faculty members from numerous departments across the university. Chemical Engineering is home to four such research centers. Its faculty and students derive significant benefits from participation in these, and in centers housed in other departments.

**Center for Advanced Process Decision-making (CAPD).**

Since 1985, the CAPD at Carnegie Mellon University has been an internationally recognized research leader in computer-aided process systems engineering. With support from the National Science Foundation, the Department of Energy, member companies and other funding agencies, the CAPD group has pioneered the discovery, development, and application of new methods for process design, analysis, and operations. With an annual research budget of about $2.5 million, the CAPD is a unique research group that deals with the development of methodologies and computer tools for process industries. The CAPD consortium currently has over 20 corporate members from the chemical and petroleum industries as well as a number of hardware and software companies. Research is directed by Professors Biegler, Grossmann, Sahinidis, Sirola and Ydstie and is carried out by over 30 graduate students and researchers within the Department of Chemical Engineering. The main areas of research include process modeling and simulation, process synthesis development, process optimization, process control, scheduling and planning, supply chain management, and information modeling.
Center for Complex Fluids Engineering (CCFE).

What do pediatric medicines, laundry detergent, cell membranes, lubricants and mayonnaise have in common? They are all complex fluids, a class of materials that includes emulsions, foams, gels, colloidal nanoparticle suspensions in liquids and liquid crystals. Complex Fluids engineering drives the development of products and processes that span the chemical, consumer product, food, pharmaceutical, and advanced materials industries.

The CCFE includes ten faculty from Chemical Engineering (Anna, Dahl, Jacobson, Khair, Prieve, Przybycien, Schneider, Sides, Tilton and Walker) and additional faculty from four other CIT departments plus the Departments of Chemistry and Physics in the Mellon College of Science. The CCFE’s research portfolio benefits from a culture of extensive cross-disciplinary collaboration based on student co-advising and open equipment sharing. Some ongoing collaborative projects in the CCFE include Dow Chemical-sponsored research into electrostatics and control of colloidal suspension stability in nonpolar liquids, an NIH and NSF funded effort to develop self-dispersing aerosol drug carriers that exploit surfactant-driven spreading processes on complex fluid subphases to better treat pulmonary infections in patients with cystic fibrosis or other obstructive lung diseases, an NSF-funded investigation that examines how non-Newtonian liquid rheology fundamentally alters electrophoretic particle motion in ways that can improve electrophoretic separation technologies, and NSF-funded research to develop surface-active polymer-grafted nanoparticles as high efficiency emulsifiers and lubricants based on an understanding of their adsorption behaviors.
Center for Atmospheric Particle Studies (CAPS).

CAPS is built around interdisciplinary research exploring the connections between atmospheric fine particles, human health effects, and climate effects. The faculty associated with CAPS are from Chemical Engineering (Pandis, Donahue), Mechanical Engineering, Civil and Environmental Engineering, and Chemistry. CAPS is now well established as a world leader in the behavior of organic particles, inorganic particles and their connection to chemistry and important processes such as ice nucleation in clouds.

CAPS is working to build closer connections with health effects research such as epidemiology, which is not carried out at CMU. Budding collaborations with health effects research at the University of Pittsburgh represent a significant potential for future research. CAPS is also focused on building international collaborations, with strong connections to several large European research programs and plans to start air quality research at the CMU Qatar campus.
Low Energy Electron Diffraction (LEED) patterns of a Pd(111) single crystal (left), and two different ordered sulfur overlayers on Pd(111) (center and right). Differences in the patterns reveal different arrangements of S atoms on the Pd surface—and provide clues about the mechanisms of deactivation of Pd catalysts by S.
Two of the most challenging aspects of running the Department of Chemical Engineering at Carnegie Mellon are finding the resources to both support the research students in the PhD program and to start the research programs of junior faculty members as they join the department. As a private institution, CMU does not have the income from the state that is available to state institutions, nor does its modest endowment generate a large fraction of CMU's operating budget. It is certainly the case that the contribution from state governments to the operations of state universities is becoming much less of a differentiator over the course of time than it was in the past. Nonetheless, CMU runs on the hard work of its faculty's teaching and writing of research proposals.

The students in the PhD program are the front line of our research programs. They are in the “trenches” driving forward the frontiers of human knowledge. They are designing and conducting experiments to elucidate various aspects of engineering science, developing new algorithms for engineering design and optimization, simulating chemical processes from the atomic to the plant-level scale, and ultimately creating new knowledge. In effect the PhD process is similar to an apprenticeship, in which students develop into independent researchers who are true masters (or doctors) of their field.

Once PhD students have completed their first year of coursework, they are expected to work full time on their research projects which typically take another four years to complete. In order to enable them to devote their full attention to their research, the department commits to providing full support for these students in the form of modest stipends and coverage of tuition. For the most part this is covered by research funds that are brought into the department by the faculty, however, these funds need to be augmented by additional resources, mostly in the form of fellowships. Fellowships help the department to attract the best graduate students from around the world.

Over the past few years the department has been extremely fortunate in receiving support for Fellowships from a variety of sources. Some come from corporate sponsors such as the Bayer Corporation, Lubrizol, Air Products and Chemicals Inc., and Exxon Mobil Corporation. Some fellowships come from federal sources such as the National Science Foundation directly to students. Many others come from the generous support of alumni and friends of the department. We are extremely grateful for the support of endowed fellowships over the past few years by the Bhutta family, Dr. Shyam Dighe, Mr. James Meade, H. William & Ruth Hamilton Prengle, Mr. John Swearingen & Mr. Roy Weiland. In addition, many alumni have generously supported the endowment of fellowships created in the memory of our colleagues Professors Robert R. Rothfus, Gary Powers and Herb Toor.

The greatest value of these graduate fellowships to the department is that they can be used to strategic advantage. For example, in the case of the fellowship being established in the memory of Herb Toor, we have chosen appropriately to use it to attract women engineers into the PhD program. Encouraging women to enter the engineering and science disciplines was one of Herb’s passions. Over the course of Herb’s career (and retirement) we achieved gender parity in the undergraduate program in Chemical Engineering at Carnegie Mellon. The next hurdle is to increase the fraction of women in the graduate program. This will pave the way for increasing the number of women joining university faculties as well as reaching the highest level in the corporate engineering world.

**ALUMNI NEWS**

Alumni Networking events were held this year in Washington, D.C., and in Korea. Associate Department Head Paul Sides & Assistant Department Head Toni Moltrot lunched with ChemE, ECE, & SCS alumni in Washington, D.C., along with ECE Department Head Ed Schlesinger, and SCS Dean Randy Bryant. Department Head Andy Gellman & Professor Myung Jhon dined with alumni in Korea.
Row 1: Jaclyn Lock, Dina Machin, Christopher Rizzo, Young-Hye Song, Abhishek Parikh, Andrew Tsai, Robert Wiegmann, Kelly Phouyaphone, Annie Zheng, Kenneth Villena, Tiffany Chan, Choi Teng Ho, Mauricio Garduno, Amanda Valente, Nicholas Grossos

Row 2: Kyle Kardish, Amy Maples, Paul Henderson, Preetha Raghu, David Rizwan, Chelsea Kennedy-Snodgrass, Andrew Passarotti, Arianna Gutierrez, Seif Yusuf, Anthony Yu, Steven Ung, Bryan Friedman, Jamie (Stephen) Vance

Row 3: Alicia Marrie, Samuel Korman, Kenneth Lui, Shafique Rashid, Christine Ndgele, Christopher Edwards, Rogaithe Shafi, Mallory Foster, Catherine Zalatan Hartzell, Diane Mattingly

Row 4: Anthony LoPresti, Brian Luong, Kiran Vepuri, Kristina Kostopoulos, Kushal Doshi, Rebecca Kim, Dana Evert-Parise, Christina Collura, Divya Choudhary, Muhammed Shodeinde, Carmeline Dalva, Nadir Hyder

Row 5: Austin Good, Sarah Link, Peter Mellott, Kelvin Hung, Russell Grant, Hsin-Jung Hsieh, Boo Kim, Natalia Tanaka, Avik Batra, Lisa Augustyniak, Alexa Beaver, Ryan Cheharske, Brian Bober, Scott Chapman, Kyle Buchholz, Erin Burnside, Eric Bosworth, Matthew Fahrenkopf, Simon Markowski

Row 6: Venkat Mukunda Nandivada, Hsin-Chen Chung, Jyoti Swarnkar, Tor Aksel Heirung, Rohan Desai, Krishna Iyengar, Zhaqia Lin, Abdulwahab Abdulwahab, Nakul Agarwal, Christine Anderson, Joshua Bondin, Tiffany Barth

Row 7: Satyajith Amaran, Prof. Spyros Pandis, Prof. Myung Jhon, Paul Arch, Adwoa Darko, Hui-Lian Leo, Karl Debiec, Fangqi You

Row 8: Prof. Shelley Anna, Prof. Lynn Walker, Prof. John Kitchin, Prof. Kris Dahl, Prof. Todd Pczybcien, Anshul Agarwal, Prof. Paul Sides, Wai Yang Cheong, Pil Seung Chung, Scott Epstein, Gabriella Engelhart Farnham, Byong Hyoek Lee, Wingki Lee, Vladimir Pushkarev, Michael Wartmann, Zhixia Zhong, Prof. Nikolaos Sahinidis, Prof. Robert Tilton, Prof Erik Ydstie, Prof. Ignacio Grossmann, Prof. Andrew Gellman
Row 1: April Watt, Skip Waldron, Sarah Unick, Anjana Tayi, Chandrasekar Sivakumar, Ann Cheng Lee, Stephanie Silliman, Jenna Schenker, Amy Harrison, Sonali Shah, Kristen Severson, Gerard Miller, Sojung Lee, Christopher Samstag, David Ryoo, Sebastien Persaud, Tiana Warren, Joshua Taylor

Row 2: Richard Pattison, Aislinn McCloskey, Briana Wallace, Laura McKee, Greta Michalczuk, Jincao Xu, Jin Liao, Sarah Elzer, Jonathan Leung, Nicole Navolio, Arina Lee, Madison Krensky, Phoebe Hung, Miriam Pinkava, Kenneth Yan, Daniel Wetzel, Eric Roudabush

Row 3: Krystin Meidell, Pallavi Nair, Mengya Lu, Shravya Mukka, Amrita Gala, Laura Ridilla, Ranjit Ramanathan, Jacob Loiferstein, Nikunja Kolluri, Si Won Choi, Sneha Joshi, Yvette Han, Heather Dolan, Modoluwa Fatukasi, Joshua Mathews.

Row 4: Shilpa George, Sumit Ghorawat, Jenny Hsu, Sneha Akhade, Akila DeAlwis, Weiwei Lin, Gurumukh Chhabra, Elliot Carnevale, Alexandra Grande, Gabriele Batton, Anisha Bhatnagar, Aaron Barnett, Rachel Bradley

Row 5: Nakul Agarwal, Trishna Saigal, Deepika Priyadarshini, Shweta Shah, Tejasvi Ashok, Sheetal Pai, Jean-Pierre Allera, Leo Ahnn, Lenny An, Courtney Baker, Georghi Baramidze, Teresa LaFollette

Row 6: Lea Hildebrandt, Juan Ruiz, Ruochen Liu, Stephen Vance, Nicolas Alvarez, William Michalak, William Hum, Viet Lam, Teresa Kirschling, Spencer Miller

Row 7: Yizhi Zheng, Dan Bickford, Chih-Wei Chu, Rui Huang, Sairam Shekhar, Sree Rama Raju Vetukuri, James Landon, Corey Dixon, Nate Bussiere

Faculty: Prof. John Kitchin, Prof. Lynn Walker, Prof. Annette Jacobson, Prof. Neil Donahue, Prof. Todd Przybycien, Prof. Shelley Anna, Prof. B. Erik Ydstie, Prof. Spyros Pandis, Prof. Paul Sides, Prof. James Schneider, Prof. James Miller, Prof. Kris Dahl, Prof. Lorenz Biegler, Prof. Nikolaos Sahinidis, Prof. Ignacio Grossmann, Prof. Andrew Gellman