

## In Honor of Tom Edgar's 65th Birthday I

**Monday, November 8, 2010: 12:30 PM**  
250 B Room (Salt Palace Convention Center)

- 12:30 PM** (101a) An Overview of Tom Edgar's Contributions to Chemical Process Systems Engineering  
B. Wayne Bequette and Dale E. Seborg
- 12:55 PM** (101b) Modeling and Control of a Radiation Therapy Couch  
Thomas J. McAvoy, Kate Malinowski, M. Ali Yousuf and Warren D. D'Souza
- 1:20 PM** (101c) Controlling Large-Scale Systems with Distributed Model Predictive Control  
James B. Rawlings
- 1:45 PM** (101d) Quality-Relevant Process Monitoring  
S. Joe Qin
- 2:10 PM** (101e) Process Systems Engineering in Pharma Product Development (to be revised)  
Gintaras V. Reklaitis
- 2:35 PM** (101f) Critical Review of 30 Years of Adaptive Control  
B. Erik Ydstie



1. **Preface in the Edgar Special Issue**  
B. Wayne Bequette  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7701-7703
2. **Extents of Reaction, Mass Transfer and Flow for Gas-Liquid Reaction Systems**  
Nirav Bhatt, Michael Anthony, Dominique Bonvoit  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7704-7717
3. **Computational Design of Polymer Nanocomposite Coatings: A Multiscale Hierarchical Approach to Property Prediction**  
Jie Xian, Yirun Huang, Charles W. Mankle  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7718-7727
4. **Controlled Formations of Nanostructures with Desired Geometries. 1. Rotaxol State Structures**  
Earl O. P. Soles, Paul I. Barton, George Stephanopoulos  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7728-7745
5. **Controlled Formation of Nanostructures with Desired Geometries. 2. Robust Dynamic Paths**  
Earl O. P. Soles, Paul I. Barton, George Stephanopoulos  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7746-7757
6. **OntoMODEL: Ontological Mathematical Modeling Knowledge Management in Pharmaceutical Product Development, 1: Conceptual Framework**  
Pradeep Suresh, Shuo-Huan Hsu, Pavan Akkisetty, Gintaras V. Reklaitis, Venkat Venkateswaramanian  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7758-7767
7. **OntoMODEL: Ontological Mathematical Modeling Knowledge Management in Pharmaceutical Product Development, 2: Applications**  
Pradeep Suresh, Shuo-Huan Hsu, Gintaras V. Reklaitis, Venkat Venkateswaramanian  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7768-7781
8. **Quantitative Optimal Experimental Design Using Global Sensitivity Analysis via Quasi-Linearization**  
Yunfei Chu, Joergen Hahn  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7782-7794
9. **Controller and Estimator Design for Regulation of Film Thickness, Surface Roughness, and Porosity Multiscale Thin Film Growth Process**  
Xinyu Zhang, Gangshi Hu, Gerassimos Okeanos, Panagiotis D. Christofides  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7795-7806
10. **Area Methods for Relay Feedback Tests**  
Jietae Lee, Su Whan Sung, Thomas F. Edgar  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7807-7813
11. **Faster Dynamic Process Simulation using In Situ Adaptive Tabulation**  
Sidharth Abrol, Mingder Lu, David Hill, Aaron Herrick, Thomas F. Edgar  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7814-7823
12. **Constrained Nonlinear Estimation for Industrial Process Fouling**  
Benjamin J. Spivey, John D. Hedengren, Thomas F. Edgar  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7824-7831
13. **Optimal Selection of Dominant Measurements and Manipulated Variables for Production Control**  
Wuendy Abi Assali, Thomas McAvooy  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7832-7842
14. **Automatic Detection of Stress States in Type 1 Diabetes Subjects in Ambulatory Conditions**  
Daniel A. Finan, Howard Zisser, Lois Jovanovic, Wendy C. Bevier, Dale E. Seborg  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7843-7848
15. **Reconstruction-Based Contribution for Process Monitoring with Kernel Principal Component Analysis**  
Carlos F. Alcalá, S. Joe Qin  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7849-7857
16. **Multivariate Statistical Process Monitoring Based on Statistics Pattern Analysis**  
Jin Wang, Q. Peter He  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7858-7869
17. **A Modular Approach to Sustainability Assessment and Decision Support in Chemical Process Design**  
Mohamad R. Othman, Jens-Uwe Repke, Gunter Wozny, Yinlun Huang  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7870-7881
18. **Fast Offset-Free Nonlinear Model Predictive Control Based on Moving Horizon Estimation**  
Rui Huang, Lorenz T. Biegler, Sachin C. Patwardhan  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7882-7890
19. **Optimal Design and Operation of a Spatially Distributed Multiscale Process, with Regard to Layer Heterostructure Growth**  
Christopher M. Behrens, Antonize Amico  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7891-7900
20. **Fault Detection and Diagnosis Using Hidden Markov Disturbance Models**  
Wee Chen Wang, Jay H. Lee  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7901-7908
21. **Simultaneous Scheduling and Control of Multiproduct Continuous Parallel Lines**  
Antonio Flores-Tlacuahuac, Ignacio E. Grossmann  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7909-7921
22. **Mathematical Modeling, Steady-State and Dynamic Behavior, and Control of Fuel Cells: A Review**  
Mona Bavarian, Masoud Soroush, Ioannis G. Kevrekidis, Jay B. Benziger  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7922-7950
23. **On the Effects of Tunable Parameters of Model Predictive Control on the Locations of Closed-Loop Eigenvalues†**  
Jorge L. Garriga, Masoud Soroush, H. M. Soroush  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7951-7958
24. **A Quasi-decentralized Approach for Networked State Estimation and Control of Process Systems**  
Yulei Sun, Nael H. El-Faraj  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7957-7971
25. **Optimization of Energy and Water Consumption in Corn-Based Ethanol Plants**  
Eliša Ahmetović, Mariano Martín, Ignacio E. Grossmann  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7972-7982
26. **Multiple Model Predictive Control Strategy for Disturbance Rejection††**  
Matthew Kuzne-Kinsey, B. Wayne Bequette  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7983-7993
27. **Multi-Scale Modeling of Heterogeneities in Mammalian Cell Culture Processes**  
Srinivas Karra, Brian Sager, M. Naeem Karim  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 7990-8008
28. **Maximum-Likelihood Parameter Estimation for the Thin-Shell Quasi-Newtonian Model for a Labor Film Extruder**  
J. C. Pinto Jr., M. Fujiwara, R. D. Braatz  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 8007-8015
29. **Area Method for a Biased Relay Feedback System**  
Jietae Lee, Su Whan Sung, Thomas F. Edgar  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 8016-8020
30. **Inference-Based Scheme for Controlling Product End-Use Properties in Reactive Extrusion Process**  
S. C. Garg, M. D. Wetzel, B. A. Ogunnake  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 8021-8034
31. **On the Calculation of Operability Sets of Nonlinear High-Dimensional Processes**  
Christos Georgakis, Lin Li  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 8035-8047
32. **Energy Flow Patterns and Control Implications for Integrated Distillation Networks**  
Sujit S. Jogwar, Prodromos Daoutidis  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 8048-8061
33. **Incidents Investigation and Dynamic Analysis of Large Alarm Databases in Chemical Plants. 5. 1 Catalytic Cracking Unit Case Study†**  
Ankur Pariyank, Warren D. Sieder, Ulku O. Otkem, Masoud Soroush  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 8062-8079
34. **Large-Scale Parallel Computation of Incompressible Flows by a Domain Decomposition-Based L Squares Finite Element Method**  
Xu Ding, Q. Y. Jiang, Tale T. H. Tsang  
*Industrial & Engineering Chemistry Research* 2010 49 (17), 8080-8085

# CEE

chemical engineering education

VOLUME 26

NUMBER 1

WINTER 1992



FOR ENGINEERING EDUCATION

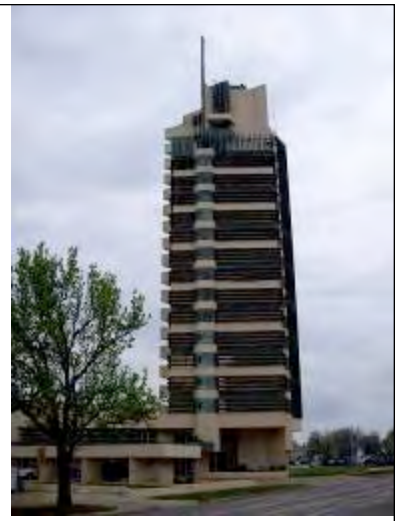
## *Thomas F. Edgar*

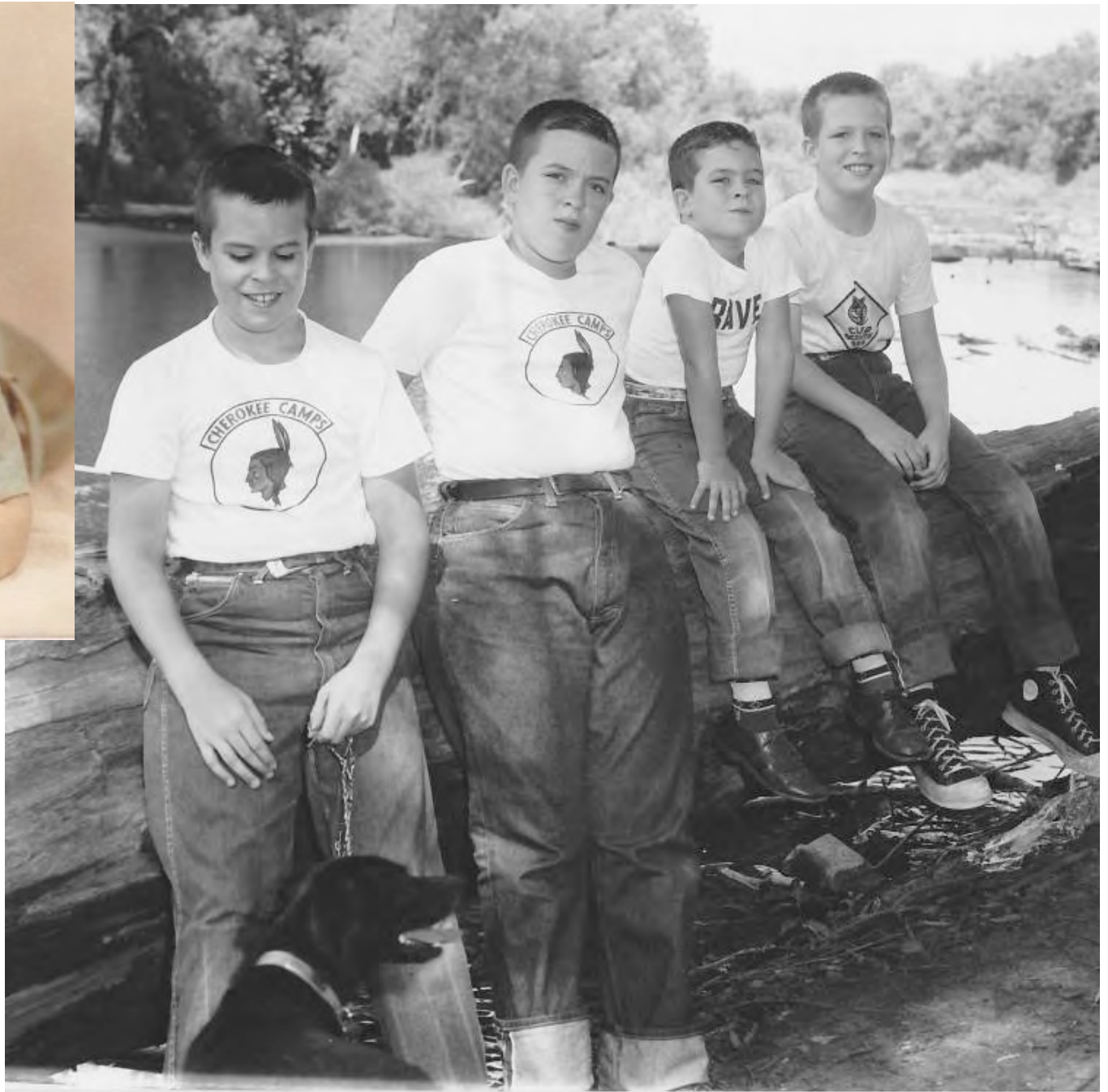
of the  
University of Texas, Austin

*AWARD LECTURE: Part 2 . . .*  
Computing in Engineering Education:  
From There, To Here, To Where?  
CARNAHAN

*and . . .*

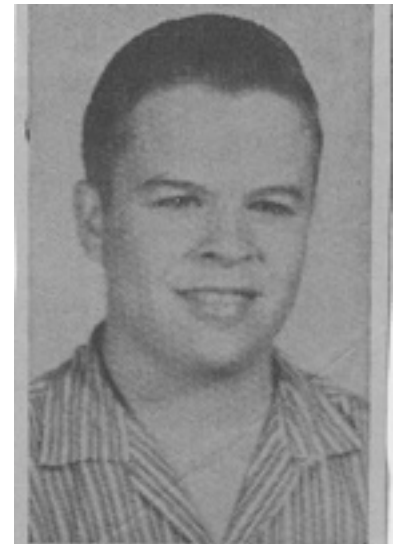






# Early Awards/Honors

- 8<sup>th</sup> Grade
  - Oklahoma State Spelling Bee champion
  - Trip to National Spelling Bee in DC
- Senior year of High School
  - Bartlesville Science Fair winner
  - Trip to National Science Fair



CHAMPION — Thomas Edgar, 14, Central Junior High School student of Bartlesville, won the 21st annual northeast Oklahoma spelling bee championship Saturday. One hundred and two spellers competed in the finals. Edgar will compete in the National Spelling Bee in Washington, D. C. on June 11.



# Undergraduate

- University of Kansas, B.S.
  - Only B in Transport Phenomena
  - NSF funded summer project on process control







• AUG



# Ph.D., Princeton 1971

*Chemical Engineering Communications*  
1973, Vol. 1, pp. 57-76

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## THE LINEAR-QUADRATIC CONTROL PROBLEM: A REVIEW OF THEORY AND PRACTICE

T. F. EDGAR†, J. G. VERMEYCHUK‡ and L. LAPIDUS§

*(Received August 4, 1972; in final form November, 1, 1972)*

The linear-quadratic control problem (LQP) assumes central importance in control theory, and therefore it has been extensively studied in the past decade. This review examines the recent developments related to the LQP, providing a comprehensive coverage for both the lumped and distributed parameter LQP's. The existing theory and practice of the lumped LQP are presented in detail, while the distributed case is considered from a different viewpoint, since its applications and solution techniques are still in a stage of development. The generalized treatment of this subject should prove useful not only to the systems engineer but also the engineer who specializes in other areas of chemical engineering.

## AICHE JOURNAL

CHEMICAL ENGINEERING RESEARCH AND DEVELOPMENT / JULY 1972

6A.5

## The Computation of Optimal Singular Bang-Bang Control I: Linear Systems

ation of both singular and bang-bang algorithm utilizes a limiting process and -quadratic control problem. The algo- th fixed and nonfixed final times. Gen- ar system examples are presented, and tussed in detail.

T. F. EDGAR and L. LAPIDUS

Department of Chemical Engineering  
Princeton University,  
Princeton, New Jersey 08540

## The Computation of Optimal Singular Bang- Bang Control II. Nonlinear Systems

A general algorithm for the computation of singular/bang-bang control, previously applied to linear systems, is extended to nonlinear systems. The minimum time control of a two-stage CSTR is demonstrated.

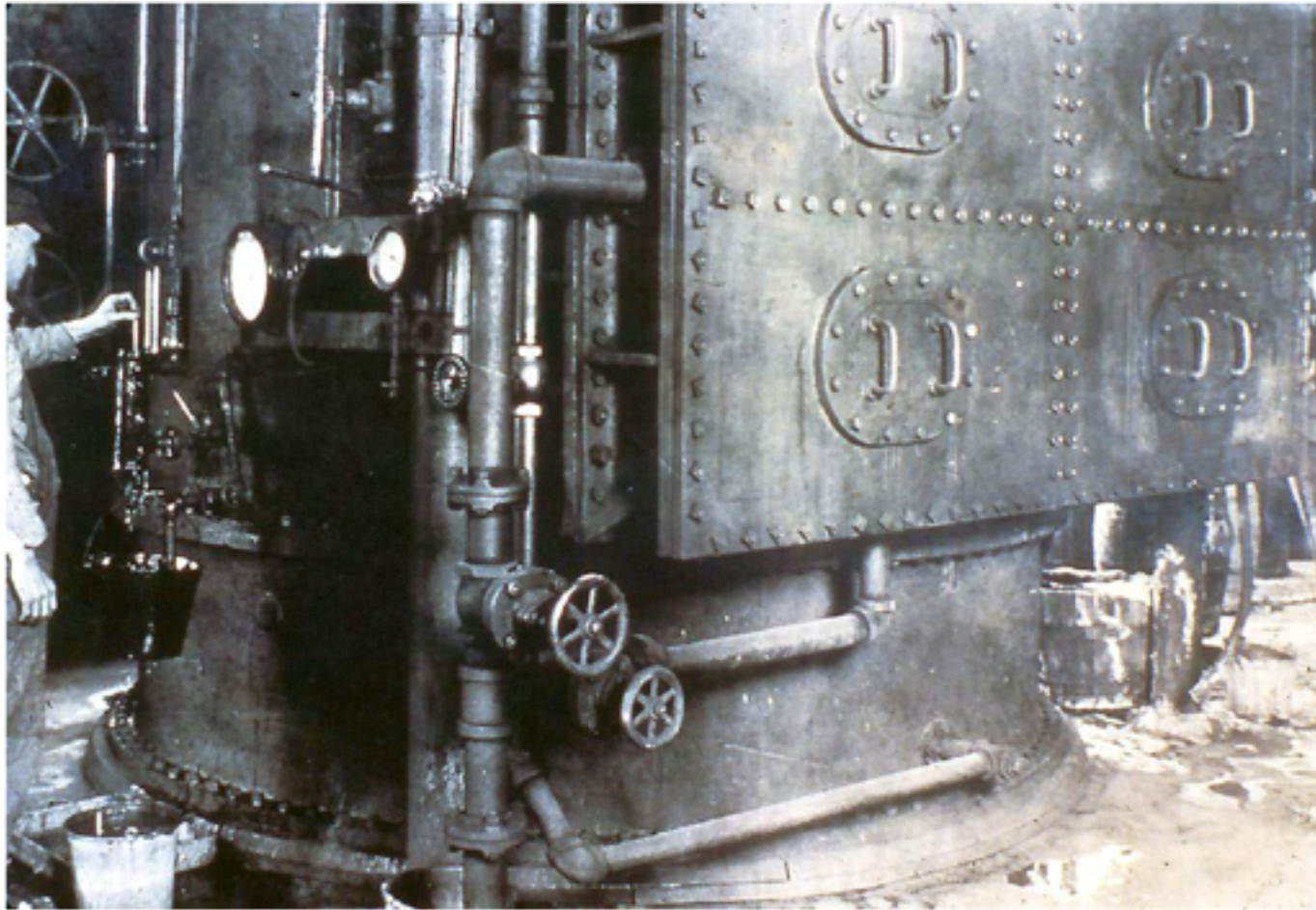
T. F. EDGAR and L. LAPIDUS

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Princeton University  
Princeton, New Jersey 08540

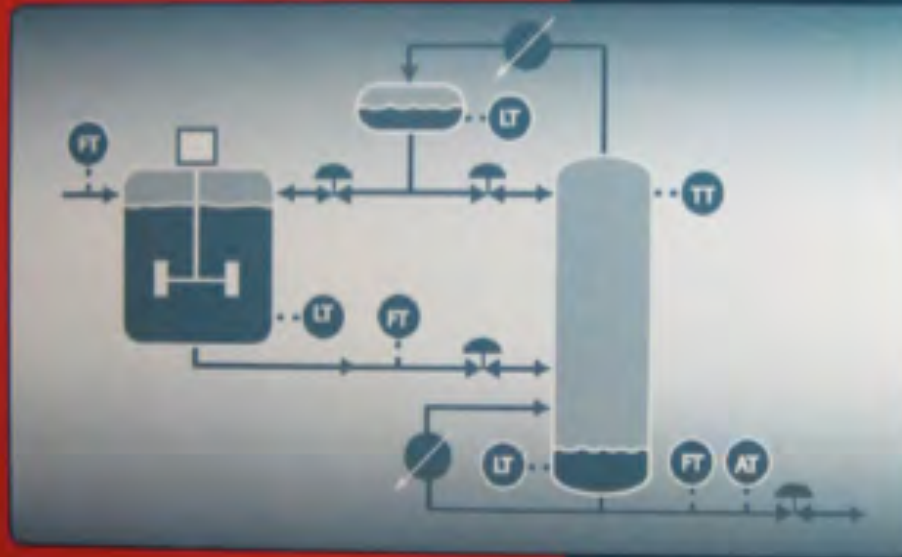








# Process Dynamics and Control



Seborg | Edgar | Mellichamp | Doyle

3rd Edition









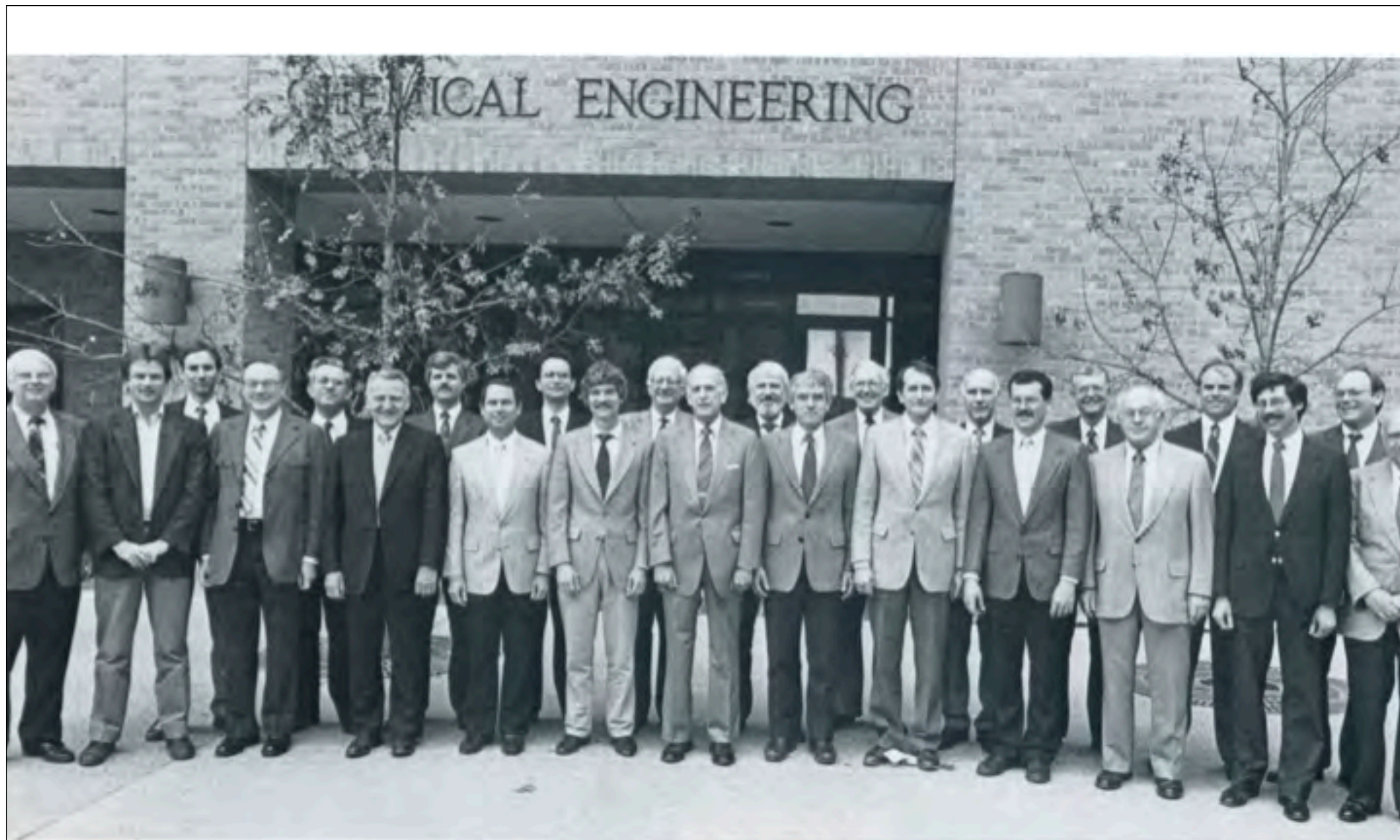
The faculty met in the Kobe Library, E.P. Schoch Laboratories, in the early 1970s. Shown, from left to right, are: D. R. Paul, J. W. Barlow, M. Van Winkle, H. Steinfink, J. E. Stice, D. M. Himmelblau, R. S. Schechter, T. F. Edgar, E. H. Wissler, J. J. McKetta. Not present: H. F. Rase, J. O. Hougen.



AICHE social events at UT in 1976–77 included a Christmas party, picnics, and a “happy hour” after each meeting. In March 1977 they took their annual plant trip to a Houston refinery. First (front) row: Johnson, M. R. Piana; second row: Barnum, Wilkins, Sipes, Arnond, Dr. T. F. Edgar; third row: Stoltz, Glover, Swinnea, Fernandez, Fletes-Lugo, Gorup; fourth row: Johnston, Fischer, Riggs, Tullis, Bishkin, Faerman, Haskin, Kolb; fifth row: Stancil, Schultz, Huff, Schooler, Davey, Dunlap, Suffredini, Horany; sixth row: Waits, Grittman, Zapata, M. L. Piana, Tuel, McRee, Siewert, Daniel; seventh row: Tiffany, York, Trigg, Stanley, Wukasch, Turner, Roderick, Smolik; eighth row: Smolen, Getz, Hunt, Fehrenbacher, Kneupper, Mendoza, Shelton, Ulrich; ninth row: Parks, Garza, Moran, Hall, Oyen, Lorimer, Noueilaty, Murray; 10th row: Cooley, Squires, Short, Bannan, Dunn, Wofford, Dr. D. R. Paul; 11th row: Moore, Dr. J. W. Barlow, Rodgers, Merriman; 12th row: Watkins, Stearns.



more about energy problems, AIChE student members invited guest speakers to meetings to discuss energy reserves, nuclear engineering and law. Front row: Essex, Lloyd, Spaid, Furlong, Looney, Earnest, Givens, Mankin, Leach, Tullis, Pitcher, Koehler, Binder, Stolle, Barnes, Drs. D. R. Paul, J. R. Fair, and J. W. Barlow; middle row: Bevil, Wright, Spielman, Frisbee, Longwell, omerville, Erb, Brysch, Kubena, Hodges, O'Connor, Morrison, Shaw, Coker, Adams; back row: Bass, Payne, Gonzalez, Penning-Shibusawa, Tyler, Gilmore, Perez, Hinz, Popielarczyk, Wahrmund, Moutos, Geiger, Porpora, Dougal, Jepsen, Toprac, McKinney,



The Fall 1988 faculty gathering included the following. Front row: I. Trachtenberg, D. R. Lloyd, D. M. Himmelblau, J. J. McKetta, D. R. Paul, J. B. Rawlings, H. F. Rase, I. C. Sanchez, G. T. Rochelle, J. A. Hubbell, H. Steinfink, W. J. Koros, H. D. Grove; back row: K. F. Johnston, A. Heller, J. G. Ekerdt, G. Georgiou, R. S. Schechter, R. P. Popovich, J. R. Fair, E. H. Wissler, J. E. Stice, T. F. Edgar (Chairman), J. W. Barlow. Not shown: J. R. Brock.

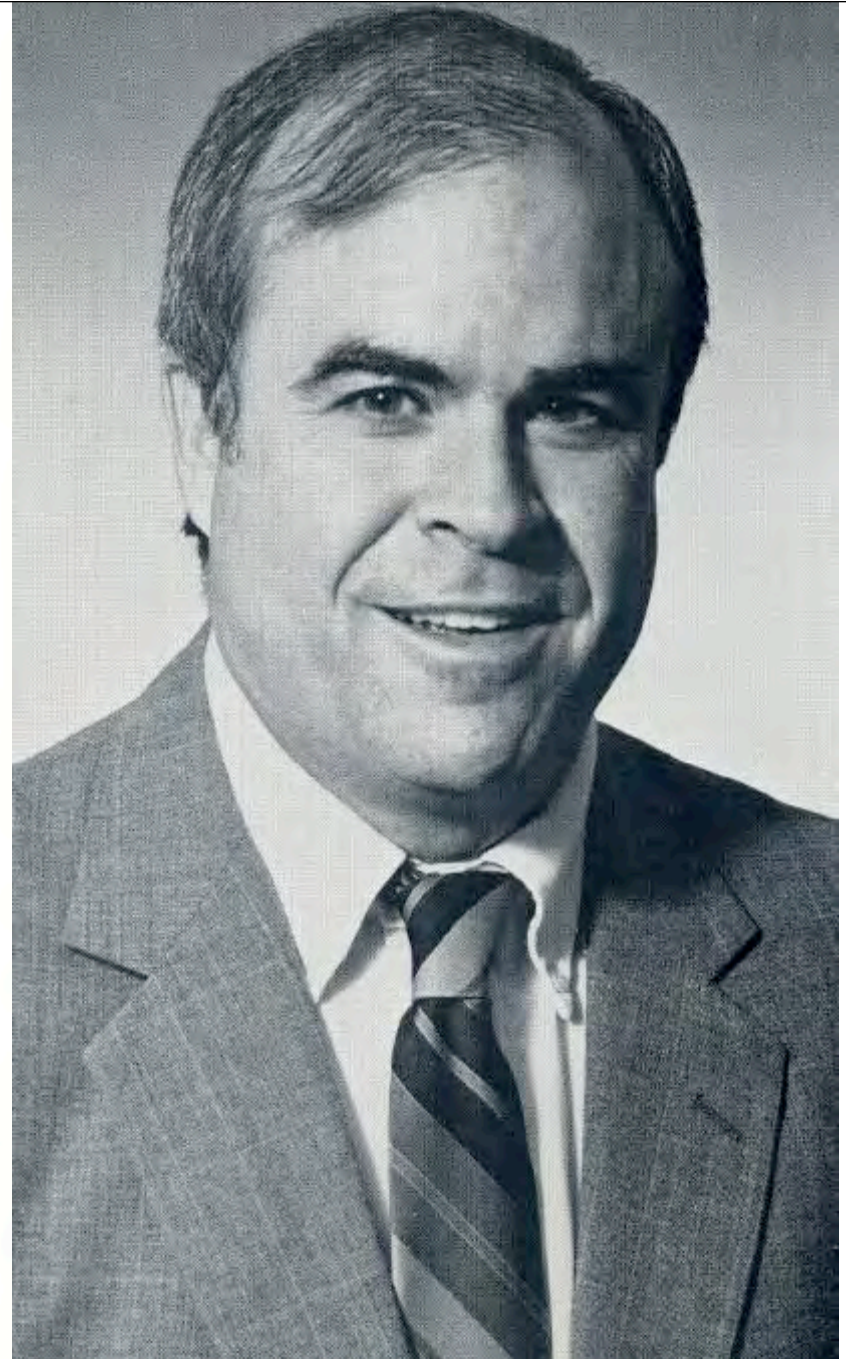
*Photo courtesy of ChE Dept. archives*

# Will Computers Control The World?

**14TH ANNUAL JOE J. KING  
PROFESSIONAL ENGINEERING  
ACHIEVEMENT AWARD LECTURE**

**By Dr. Thomas F. Edgar, P.E.**  
Professor of Chemical Engineering and  
The Paul D. and Betty Robertson Meek  
Centennial Professor in Chemical Engineering

February 22, 1989  
College of Engineering  
The University of Texas at Austin



## Mathematical Modeling and Global Warming

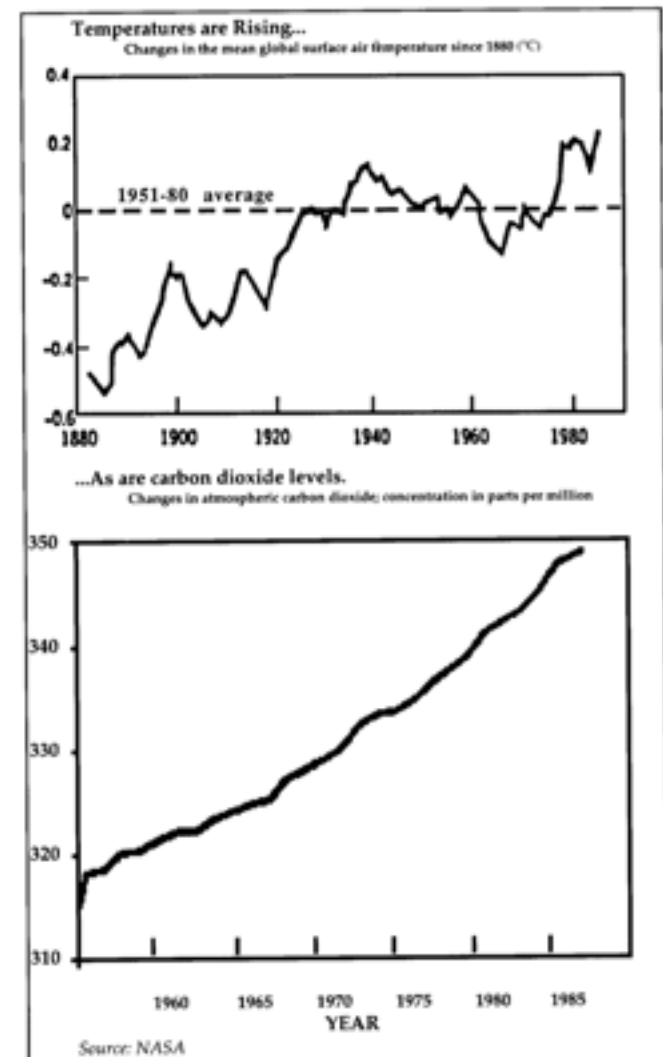
I would like to discuss briefly the last topic, environmental quality, as an example of an area where a "systems" approach will be necessary to reach a meaningful solution. During the past year we have heard many statements by experts and non-experts about the phenomenon of global warming and its potential implications. An increase in the earth's temperature may cause precipitation changes, mid-continent drought, reduction of sea ice, and a rise in global mean sea level. The subject of global chemistry and heat transfer is of interest to chemical engineers because the environment can be likened to a giant chemical reactor. In fact, in 1896 the Swedish chemist Arrhenius, well-known to chemical engineers for his work with chemical reaction kinetics, was one of the first notables to make predictions about global warming. This phenomenon is of interest to modelers because of the large number of interdependent physical and chemical processes that affect the earth's temperature and atmospheric chemistry. There is a dearth of information about which variables influence heat transfer from the sun; for example, the role of clouds has yet to be quantified. It is a

Joe J. King Award Page 25

As the world has become more industrialized, two facts are indisputable: more fossil fuels are being consumed, producing more carbon dioxide ( $\text{CO}_2$ ). Much of the world's forests have been exploited and removed, mainly in non-industrialized nations, reducing the global capability to consume  $\text{CO}_2$ . In general the cleared land has not been successfully converted to agricultural purposes [16,17].

The projected increase in temperature is correlated with  $\text{CO}_2$  concentration because atmospheric  $\text{CO}_2$ , as well as water vapor and ozone, absorb a portion of the infrared heat radiation coming from the surface of the warmed earth, re-radiating part of it back to the surface. The heat is trapped in the atmosphere in the same way that heat is trapped inside a greenhouse, hence it is called the "greenhouse effect." Most scientists believe that a continued increase in  $\text{CO}_2$  levels, depletion of the ozone layer, and a buildup of atmospheric methane will gradually increase the earth's temperature [18].

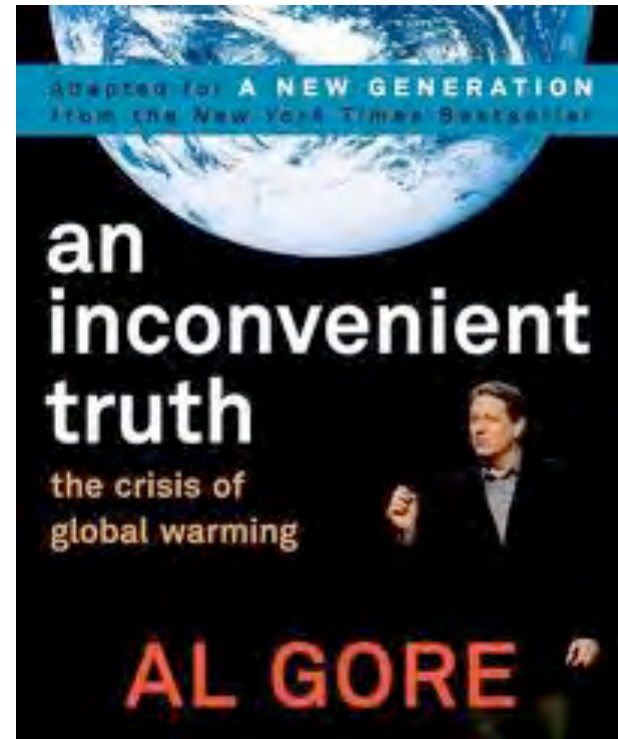
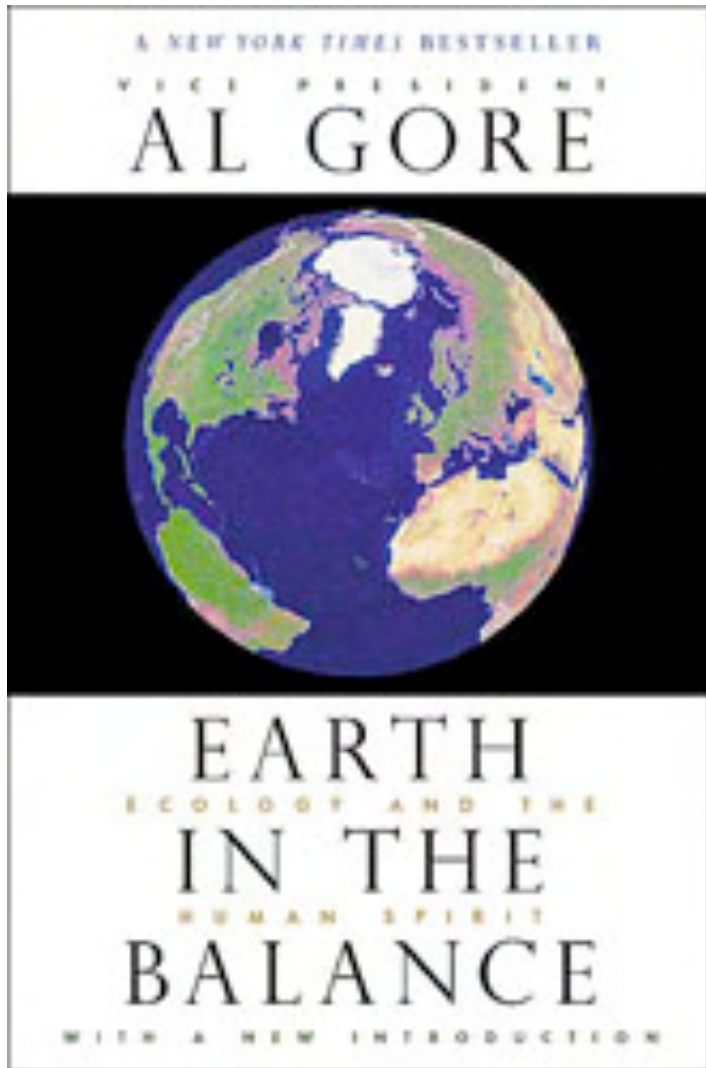
A global  $\text{CO}_2$  balance is difficult to perform because of the natural effects of forests and grasslands as well as the time-dependent capability



Joe J. King Award Page 26







# Industrial Career Achievement Award, CPC 1991

Tom Edgar

- For spending one year at a Conoco plant twenty years ago

# Ragazzini Award, 1992



*AACC award winners left to right, Stephen P. Boyd, Elling W. Jacobsen, Sigurd Skogestad, and Thomas F. Edgar. Not pictured is Rutherford Aris.*



*Each year, the top three vote getters are inducted by their peers into the Process Automation Hall of Fame. The careers of this year's class run the gamut from the theoretical to the ruthlessly practical.*

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## THE ACADEMICIAN



*Tom Edgar is grandmaster of control theory.*

"My obsession is the energy situation," says inductee Thomas F. Edgar. "I teach a class at UT on energy policy and technology, have read several books by Tom Friedman recently and I also like The End of Oil by Paul Roberts." Another twisty path?

Maybe so, but for the past 35 years, Edgar has concentrated his academic work in process modeling, control and optimization. He has published over 200 articles and book chapters in those fields applied to separations, chemical reactors, coal combustion and gasification, and semiconductor manufacturing. He has supervised the thesis research of over 42 M.S. and 60 Ph.D. students. He also co-directs the Texas-Wisconsin Modeling and Control Consortium, which involves 12 companies.



## Optimization of Chemical Processes [Paperback]

[Thomas F. Edgar](#) (Author), [David M. Himmelblau](#) (Author)

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# Guest Speaker





