

Princeton University

HONORS FACULTY MEMBERS
RECEIVING EMERITUS STATUS



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The biographical sketches were written by staff and colleagues in the departments of those honored.

CONTENTS

Faculty Members Receiving Emeritus Status 2017

Dilip J. Abreu	3
Anne Catherine Case	6
Esther da Costa Meyer	9
Benjamin A. Elman	11
Joan Stern Girgus	13
Jan T. Gross	17
Barry Leonard Jacobs	20
Robert Owen Keohane	22
Yannis George Kevrekidis	26
Daniel N. Osherson	29
Samuel George H. Philander	33
Jean-Herve Prévost	36
Mark David Rose	39
Lawrence Rosen	42
William Bailey Russel	45
George W. Scherer	48
Brent Donald Shaw	50
Arthur John Stewart Smith	54
Edwin S. Williams	57

YANNIS GEORGE KEVREKIDIS



Yannis George Kevrekidis, the Pomeroy and Betty Perry Smith Professor in Engineering, professor of chemical and biological engineering, and senior faculty in the Program in Applied and Computational Mathematics, will be transferring to emeritus status on July 1, 2017, after thirty-one years on the Princeton University faculty.

Yannis (as he is commonly known) was born in Athens, Greece, in 1959. He received an undergraduate (five year) degree in chemical engineering from the National Technical University of Athens in 1982, and an M.A. in mathematics and Ph.D. in chemical engineering from the University of Minnesota in 1986. His doctoral advisers were Rutherford Aris and Lanny Schmidt, and his thesis was “On the Dynamics of Chemical Reactions and Reactors.” He was appointed assistant professor in the chemical engineering department of Princeton University in 1986 and was promoted to associate professor in 1991, and to professor in 1994.

Research in Yannis’s group has focused on the dynamic behavior of chemically reacting systems, and the development of innovative computer-assisted techniques for modeling engineering processes. At the beginning of his career, he studied nonlinear dynamics, instabilities, spatiotemporal pattern formation, and bifurcations in chemically reacting systems. He pioneered the fabrication and exploration of microdesigned addressable catalysts, in collaboration with the group of Gerhard Ertl, the 2007 Nobel Laureate in Chemistry, at the Fritz Haber Institute of the Max Planck Society in Berlin, and invented a systematic approach to reveal new knowledge through computation in complex, multiscale reacting systems—his equation-free framework. In a pioneering *Science* paper in 1994, the use of microlithography to construct controlled size/geometry domains on single crystal catalysts was introduced; this experiment, motivated by and designed through theory, marked the beginning of a fertile collaboration with Ertl. The work was coupled with the development of novel resolved surface microscopy techniques that enabled an unprecedented link between experiments and computer modeling. In 2001 came a breakthrough: construction of the first

microaddressable catalytic surface, where sensing (through resolved surface microscopies) and actuation (via laser beams manipulated through galvanometer mirrors) were coupled at an unprecedented spatiotemporal resolution.

Yannis's equation-free modeling constitutes an extraordinary body of work that started to appear in 2000. It brings a systems engineering, input-output approach to the way complex simulations are performed and processed. Yannis's simple, yet seminal, idea is to treat atomistic or fine-scale simulators as experiments that can be designed, initialized, and run at will. The derivation of macroscopic equations is circumvented, and systems-level modeling tasks (prediction, stability analysis, and control design) are performed directly through efficient and judicious use of the fine-scale model (e.g., using short simulation "bursts" to evaluate numerically the derivatives of macroscopic observables). The approach has remarkable generality; bridges continuum modeling, applied mathematics, and scientific computation with microscopic/atomistic physics approaches; and is transforming the way complex, multiscale systems are being modeled—a vital interdisciplinary research frontier. Example applications include accelerating convergence and obtaining stability information for process simulators, kinetic Monte Carlo simulations for catalytic surface reactions, multiphase flow and plasma modeling problems, liquid crystals, micelle formation, cell motility, and more.

Yannis has been recognized with numerous honors and awards, including the 2016 W. T. and Idalia Reid Prize in Mathematics of the Society of Industrial and Applied Mathematics, and the 2010 Wilhelm Award, and the 1994 Allan P. Colburn Award for Excellence in Publications by a Young Member of the Institute of the American Institute of Chemical Engineers. He was elected a corresponding member of the Academy of Athens in 2015. He has held distinguished visiting fellowships at the Albert Einstein Foundation and Zuse Institute Berlin (2016-18), Isaac Newton Institute of Mathematical Sciences of Cambridge University (2016 and 2013), Max Planck Institute for the Physics of Complex Systems (2010-11), California Institute of Technology (2005), and Center for Nonlinear Studies at Los Alamos National Laboratory (1994-95).

He has advised or co-advised twenty-five Ph.D. students in chemical engineering (also four in applied mathematics), many of whom have gone on to prominent positions in academia (including

Stanislav Y. Shvartsman at Princeton) and industry (e.g., three Ph.D. alumni now with ExxonMobil). He has also advised a very strong cohort of postdoctoral scientists (fifteen in U.S. and international academic positions) and dozens of successful undergraduate senior theses at Princeton.

He has served on departmental advisory councils (e.g., University of California, Santa Barbara, Indian Institutes of Technology, University of Crete), as an industry and government consultant (e.g., ExxonMobil, Shell, United Technologies Research Center, Los Alamos National Laboratory), and as an associate editor for several archival journals, both in chemical engineering and in applied mathematics. He has been honored with four Engineering Council Teaching Awards at Princeton, selected by student vote, as well as with the Distinguished Teacher Award from the School of Engineering and Applied Science at Princeton. He has been consistently sought after as an invited/plenary/seminar speaker, and a lecturer in scientific summer schools.

Following his retirement from Princeton, Yannis will be moving to a Bloomberg Distinguished Professorship at Johns Hopkins University, where he will be affiliated with the Departments of Chemical and Biomolecular Engineering, Applied Mathematics and Statistics, and Urology (the latter in the Johns Hopkins University School of Medicine). We look forward to continuing interactions with Princeton from his new position, and wish Yannis, his wife Stavroula, and their daughter Domna all the best for their future endeavors in Baltimore.