Sébastien Candel, Professor of Aerospace Engineering and Head of Mechanical and Aerospace Studies at École Centrale Paris, received an engineering degree from École Centrale Paris in 1968, a Ph.D. from the California Institute of Technology in 1972, and a Doctorat d'Etat from U. Paris 6 in 1977. He was a research scientist at ONERA (the French Aerospace Research lab) from 1973 to 1987 and an assistant professor at University of Compiègne. Since 1978 he has been a professor at École Centrale Paris. In 2001 he was appointed as a senior member of "Institut Universitaire de France." He was awarded the silver medal of CNRS, received the Marcel Dassault Grand Prize from the Academy of Sciences, the Aeroacoustics award from the Confederation of European Aerospace Societies, and the Pendray Aerospace literature award from AIAA.

He is a fellow of the AIAA, the "Association Aeronautique et Astronautique de France" and the Institute of Physics. He is a corresponding member of the French Academy of Sciences, a member of the Academy of Technology and a foreign member of the National Academy of Engineering of the United States. He was a vice-president of the Combustion Institute, and is a member of the research and technology evaluation committee of Centre National d'Etudes Spatiales. He has been an associate editor of *Combustion and Flame* and of the *Comptes Rendus de l'Académie des Sciences*. He also serves on the editorial boards of *Combustion Science and Technology*, *Progress in Energy and Combustion Science*, *Journal of Turbulence* and *Aerospace Science and Technology*. His research interests are in combustion, aeroacoustics and propulsion. He is the author or co-author of two books and of more than 160 journal articles and more than 230 conference proceedings and book sections.

The Department of Mechanical Engineering
at the University of Connecticut

Presents

The Pratt & Whitney Distinguished Lecture by

Prof. Sébastien Candel

Laboratoire Énergetique Moléculaire
et Macroscopique, Combustion (EM2C)

École Centrale Paris, Châtenay-Malabry, France

"Progress and Challenges in Combustion Dynamics"

Wednesday, April 28, 2010
3:00 PM

United Technologies Engineering Building, Room 150

The lecture will be followed by a reception
in the UConn Alumni Center Great Hall.

"Progress and Challenges in Combustion Dynamics"

Combustion dynamics raises difficult questions and constitutes a challenging area in combustion research and in practical applications. Many current problems have their origin in the advanced technologies exploited in gas turbines where premixed combustion is used to reduce NOx emissions but is sensitive to resonant acoustic coupling leading to instability. Dynamical phenomena have detrimental effects and are specifically damaging in high performance devices where the energy density is important, a situation prevailing in gas turbines, aero-engine combustors or in rocket engine thrust chambers. Many aspects of this topic have been investigated over the past decades for their fundamental and practical implications. Progress has been made more recently in the experimental analysis of the driving and coupling mechanisms, in the development of reduced order models and in the exploration of unsteady combustion processes with large eddy simulations.

After a short review of central problems in combustion science, this lecture proposes a synthesis of advances in combustion dynamics. Investigations of perturbed flame dynamics are described. The response of flames to incoming perturbations of various types is specifically considered. Nonlinear features of combustion instabilities are analyzed in a second stage and it is shown that harmonic balance methods based on the flame describing function (FDF) can be exploited to suitably represent phenomena like limit cycle oscillations, frequency shifting during transient growth, mode switching and instability triggering. Progress is also related to advances in computational flame dynamics as illustrated by calculations of perturbed flames and of self-sustained oscillations in annular combustor configurations. New concepts for the dynamical control of instabilities have also been devised and will be described in the final part of this presentation.