UNIVERSITY OF MARYLAND

THE BURGERS PROGRAM FOR FLUID DYNAMICS
SEVENTEENTH ANNUAL BURGERS SYMPOSIUM
BURGERS LECTURE

COMBUSTION DYNAMICS IN TURBULENT FLAMES AND THE PATH TO INSTABILITY

Friday, November 6, 2020 | 11am EST
Zoom link: https://umd.zoom.us/j/96931199691
Meeting ID: 969 3119 9691

Burgers Lecturer

DR.IR. J.B.W. (JIM) KOK

Associate Professor
Faculty of Engineering Technology
University of Twente

ABSTRACT

For the design and operation of Gas Turbine engines a key element is the reduction of polluting emission of nitric oxides that are produced in the combustion process of the fuel. This reduction of emission of nitric oxides can be achieved by the use of lean premixed combustion. This kind of combustion design is vulnerable to high amplitude pressure pulsations that may develop because of the coupling between the pressure field and the heat release fluctuations, known as thermoacoustic instabilities, and can result in structural damage. Lean combustion is employed successfully already for stationary GT engines fired on natural gas. The next challenge is to apply lean combustion to aero GT engines that are fired on jet fuel. For aero engines the need to predict and avoid these instabilities is even more important than for stationary engines.

In order to predict the transition point from stable to unstable operation and acquire information that can lead us to the prevention of thermo acoustic instabilities, the combustion processes are explored in two configurations. They are both developed in EC funded Marie Curie ITN projects that were coordinated by the University of Twente. These are a natural gas fired turbulent atmospheric combustor (LIMOUSINE project) and the jet fuel fired pressurized turbulent combustor developed in the currently running MAGISTER project. Discussed will be the behavior of gas and liquid fuel flames and the analysis of the acquired data with the help of the familiar chaos theory and more recent machine learning methods.

BIO

Jim Kok (Alkmaar/NL, 1960) received his MSc degree in Mechanical Engineering in 1985 at the University of Twente (Enschede, NL). Subsequently he obtained his PhD degree at this university in 1989 under supervision of Professor Leen van Wijngaarden on the subject of dynamics of gas bubbles moving through liquid. Subsequently he became a member of faculty. In 1996-1997 he spent a year as a visiting associate Professor at the Sibley School of Engineering at Cornell University in Ithaca, NY. Since 1989, he performed research on turbulent combustion with application on gas turbine engines. Before 2000 the focus was on reduction of nitric oxide emission, but since then the interest focused on the interaction of combustion dynamics and acoustics and engine design and operation. The work involves both CFD modeling and experiments. On this topic he coordinated the EC/ ITN project LIMOUSINE (2008-2012, 15 PhD students) and currently the EC/ITN project MAGISTER (2017-2021, 15 PhD students). The latter project aims on the application of Machine Learning on the analysis and characterization of combustion dynamics and related acoustics.

A. JAMES CLARK SCHOOL OF ENGINEERING

INSTITUTE FOR PHYSICAL SCIENCE & TECHNOLOGY
BURGERS PROGRAM FOR FLUID DYNAMICS