Combustion Kinetics

杨斌 特别研究员， *清华大学*

The Course focuses on the development, validation and analysis of detailed chemical kinetic mechanisms to describe the oxidation of hydrocarbon and oxygenated hydrocarbon fuels, which will help students advance the understanding of combustion at molecular level and learn the frontier of the combustion kinetic research

PDF/FDF Methods for Turbulent Reactive Methods.

Prof. Peyman Givi， *美国匹兹堡大学*

The objective of this course is to provide a comprehensive and understandable review of the theoretical foundations of the probability density function (PDF) approach for modeling of chemically reactive turbulent flows problems. These methods are widely recognized as the most comprehensive means of Reynolds averaged turbulent combustion modeling (widely referred to as Reynolds-averaged navier Stokes (RANS)). The principal objective of the course is to go through the derivation of modelled transport equation(s) for the PDF of the transport variables in turbulent flows, and present ways of solving the equation(s) numerically. In doing so, a tutorial will be provided of the stochastic differential equations and their application for modeling and simulation of the PDF transport equations. The extension of this probabilistic scheme for large eddy simulation (LES) involves the use of the filtered density function (FDF) which provides a very systematic means for the closure of the subgrid scale quantities in turbulent combustion. Some examples will be provided of recent simulations via both RANS/PDF and LES/FDF methodologies.

Flame Fundamentals

Prof. Hong G. Im

美国密歇根大学，阿卜杜拉国王科技大学（沙特阿拉伯）

Course Description

The scope of the course is largely focused on physical aspects of fundamental laminar flame theory with application of numerical simulations. The lectures will be given in two 3-hour sessions, during which basic phenomenological, theoretical, and computational aspects of analyzing and understanding the flame physics will be discussed. A tentative list of topics covered include:

Day 1

- Classification of flames
- Practical examples of combustion applications
- Review of conservation equations and concepts of conserved scalar
- The asymptotic theory of flames
- The S-curve and Damkohler number scaling

Day 2

- Benchmark laminar flames
- Intrinsic flame instabilities
- Aerodynamics of flames
- Turbulent combustion regimes
- Computational aspects of combustion modeling – DNS/LES/RANS
- Future Research Direction
  - High pressure
  - Ignition-dominant combustion – MILD combustion
  - Supercritical CO2
  - Sunfuels and PPC

Turbulent Combustion

Prof. Chenning Tong， *美国克莱姆森大学*

The course will discuss the fundamentals of turbulent combustion, including turbulence and turbulent flows, non-premixed turbulent combustion, and premixed turbulent combustion. The emphasis is on turbulence-chemistry interaction and non-equilibrium combustion processes.

Radiative heat transfer in combustion

蔡健 *教授，* *中国地质大学*

Radiative heat transfer, as energy transfer by electromagnetic waves, is important in combustion. It is traditionally divided into two parts, namely surface-to-surface radiation and radiation in participating media. Solving surface-to-surface radiation includes view factor methods for simplified configurations or the Monte Carlo Method for general configurations. Radiation in participating media is governed by the radiative transfer equation. Solving the radiative transfer equation requires two separate models, namely a spectral model and a radiative transfer equation model. The spectral model is based on the spectroscopic properties of the participating media. The radiative transfer equation model has three categories, namely the Discrete Ordinate Method, the Spherical Harmonic Method, and the Monte Carlo Method. Turbulence-radiation interactions found in turbulent flames need separate treatments on emission and absorption. Multiphase radiation in gas-solid combustion will also be briefly discussed.