Advanced multiphysics CFD solutions for combustion modeling

FINE™/Open with OpenLabs™ allows robust and CPU-efficient simulations of industrial combustion processes

KEY FEATURES
- PARALLEL AUTOMATIC CAD CLEANING AND MESHING WITH HEXPRESS™/HYBRID
- COMBUSTION MODELS FOR ALL REGIMES
- FGM – FLAMELET GENERATED MANIFOLDS APPROACH
- EASY-TO-USE GUI FOR COMBUSTION & RADIATION MODELING
- FULLY COMPATIBLE WITH OPENLABS™ FOR MODEL CUSTOMIZATION & EXTENSION

INDUSTRIAL APPLICATIONS
- Gas turbine combustors
- Aero-engine combustors
- Furnaces
- Burners
- Boilers
- General combustion applications

Simulation of a furnace using FINE™/Open with OpenLabs™

Lean gas turbine combustor of Siemens

Gas turbine combustor of Siemens - Computational results using FGM
Robust, accurate & reliable models for all types of combustion

The combustion models can be coupled with:
- Conjugate Heat Transfer (CHT) module
- Lagrangian module (spray combustion)
- Radiation models
- Pollutant formation models

Combustion models:
- Flamelet/equilibrium approach
- Flamelet Generated Manifolds (FGM) method
- Hybrid BML/flamelet method
- BML method

Radiation modeling:
- Finite-Volume-Method for radiative heat-transfer
- P1 model
- Emission model
- Surface-to-surface model

Pollutant modeling:
- NOx postprocessing
- Soot modeling (OpenLabs™):
  - Greeves & Khan
  - Tesner
  - Brookes/Moss/Lindstedt

TabGen/Chemistry - Powerful combustion table generation tool
- Automatic table generation. User only needs to specify table type, temperature and composition of fuel and oxidizer streams, as well as the governing pressure
- Preintegration of combustion tables for turbulent flows using β-PDF

OpenLabs™ GUI

Figure 1

\[ \frac{\partial (\rho Y)}{\partial t} + \nabla (\rho v Y) = -\nabla Dv + \frac{\rho}{\sigma_D} \frac{\partial}{\partial Y} \Rightarrow Le = \frac{\sigma_D}{\rho D} \]

LABS 1

**EQUATIONS**
@ PDE: concentration Equation
- EXPRESSION: DOT(Y) + CONV(Y) = DIFFl(Y, diffl.coeff) + (Y, Y.diff coeff).
  - Convective_Scheme: UpwindFirstOrderConservative
  - UseCustomBC: ConcentLow, DOR_IN
  - UseCustomBC: ConcentHigh, AC_IN
  - INITIAL_VALUE: 0.9

**ALGEBRAIC_DIFFUSION_COEFFICIENTS**
@ ALGDIFFCOEFF: Y_diff_coeff
- EXPRESSION: Conductivity / phys_co_1 * Le + EddyVisc/SigmaY

Figure 2

OpenLabs™: Example of a Lab to add a Transport equation for the pollutant mass Fraction. Figure 1: the transport equation — Figure 2: the lab

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