Poster P-15

CFD Combustion Modeling with Conditional Moment Closure using Tabulated Chemistry

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Problem:

$$\frac{\partial \bar{\rho}\tilde{Y}_i}{\partial t} + \nabla \cdot \left(\bar{\rho}\tilde{v}\tilde{Y}_i\right) - \nabla \cdot \left(\bar{\rho} D_t \nabla \tilde{Y}_i\right) = \bar{\rho}\widetilde{\omega_i}$$

$$\widetilde{\omega_i} \neq \omega_i(\vec{x};\, \tilde{T}, \tilde{\mathbf{Y}}, \bar{p})$$

One possible solution:

$$\frac{\partial Q_i}{\partial t} + \langle \boldsymbol{v}|\eta\rangle \cdot \nabla Q_i = \langle N|\eta\rangle \frac{\partial^2 Q_i}{\partial \eta^2} + \langle \omega_i|\eta\rangle$$

Q_i: conditional mean $\quad \langle \omega_i|\eta\rangle = \omega_i(\mathbf{Q}, \eta)$

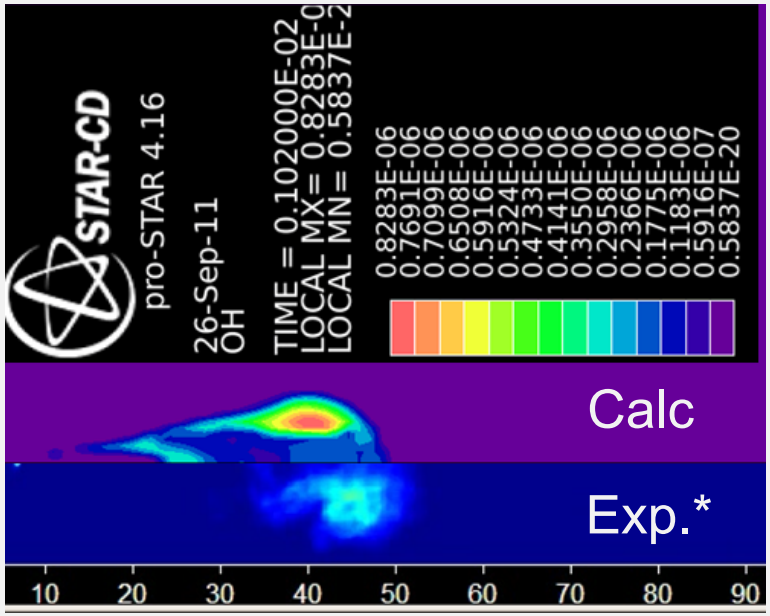
Implementation:

Problem: CPU and memory cost
$(N_s + 1) \times N_{G,\eta}$ in each cell

Solution: Tabulated chemistry

Sample result:

Spray bomb, 12 % O_2 (vol.)
ρ = 14.8 bar, T_{amb} = 1000 K



OH signal at 1.02 ms ASOI

*http://www.sandia.gov/ecn/cvdata/constantVol.php