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Introduction

Stabilized combustion is widely used when the flame needs to be anchored at a desired location and is resistant to flash back, lift off or blow off in operating range. There are two aerodynamic ways, one is to stabilize flame in the wake of bluff-body, and one is to stabilize flame in the low-velocity region of swirling flow. Here report one numerical study of a diffusion flame with both two mechanisms. This research chose one middle swirling case (SM1) from Sydney swirling flame series.

This burner is built up base on a bluff-body burner with diameter D=50mm. Swirling flow, which is generated aerodynamically upstream, comes out from annular exhaust with width d=5mm. Fuel jet comes from central hole in bluff-body with diameter d′=3.6mm. Velocity and composition measurements are resolved separately in two cross sections. Main properties of SM1 are summarized in table below.

<table>
<thead>
<tr>
<th>Key features of SM1 case</th>
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<tbody>
<tr>
<td>Case</td>
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<tr>
<td>SM1</td>
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</tbody>
</table>

Numerical method

This research use large eddy simulation (LES) in software ANASYS FLUENT. Simulation domain is a cylinder with diameter of 200mm and length of 240mm. It starts from exit of the burner. Hexahedral grid divides the domain as spatial filter in implicit LES. There are total 2.42M cells. The size of the cell is decided by Kolmogorov scale from previous RANS results. Pave mesh is used in central region while the stretching is less than 8% in the environment flow field. Complex velocity inlet is used for fuel-jet and swirling flow. 1/7-power law profile with turbulent profile (turbulent-energy and turbulent-diss-rate). Spectral synthesizer method is used to generate pseudo-fluctuation. Discretization scheme used in LES has second order. Numerical models are summarized below.

Models used in LES

<table>
<thead>
<tr>
<th>Closure term</th>
<th>Sub-grid scale</th>
<th>chemistry</th>
<th>Turb.-chem. interaction</th>
<th>model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Sma-</td>
<td></td>
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<td></td>
<td>GRI-2.11</td>
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<tr>
<td>gorinsky-Lilly</td>
<td></td>
<td>16 species</td>
<td></td>
<td>Steady flamelet</td>
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<td>Probability density function (PDF)</td>
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<td></td>
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</tbody>
</table>

Reference