Mixing and Velocity: objectives and modelling data collection for ECN2

Modelling:
Gianluca D'Errico(gianluca.derrico@polimi.it)

Experiments:
Louis-Marie Malbec (louis-marie.malbec@ifpen.fr)

Objectives of this session

- Characterization of:
  - the velocity field within the spray (PIV)
  - the mixture fraction (Rayleigh scattering)
- Results will be used:
  - to check reproducibility between facilities
  - to analyze the consistence between velocity fields and mixture fractions
  - as input data for model validation
  - as reference for comparison between different models

Experimental target conditions

- Spray A – 0% O_2 (High speed PIV is going to be performed at IFPEN in April/May 2012)

- 1st order parameters:
  - Density variation (7.6,15.2 kg/m3)
  - Injection pressure variation

- 1st order parameters:
  - Spray A – 15% O_2
  - Temperature variation

Data Needed from Experimentalists

- Macro-spray development and vaporization:
  - Liquid length
  - Spray tip penetration
  - Vapor penetration
  - Spreading angle

- Microscopic spray development and vaporization
  - Spray penetration and velocity in the near-field
  - Spreading angle
  - Microscopic features (fuel ligaments, droplet formation…)

- 2-D images for support

Quantities to be compared

- Mixture fractions
- Mixture fraction variances
- Velocity fields

Spatial positions and timings

- Spatial positions
  - Minimum: at centerline and radial positions (x= 10mm, x=25mm, x=45 mm).
  - Ideally: In the whole spray
- Timings
  - Minimum: in steady-state (1400µs ASI)
  - Ideally: Time resolved acquisition (eg. PIV @ 5000Hz or maybe higher at IFPEN)

Format of submitted results

- Text files

Deadlines

- Experimental data used for spray analysis
  - Start of experiments: 01/05/2012
  - Results ready: from 01/07/2012

- Computational results:
  - **All results must be provided by 01/07/2012**

Baseline/Standard Suggestions

Turbulence model	RANS: RNG k-ε
Spray models: Injection Atomization & Breakup Collision Drag Evaporation Heat Transfer Dispersion	 Blob KH-RT: With break-up length O'Rourke Dynamic Frossling Ranz-Marshall Stochastic
Grid: Dimensionality Smallest grid size	 Full-3D domain 0.25 mm
Preferred time-step size (ms)	Min: 5E-7

- **Contributors are invited to provide <u>one set of results</u> according to these standards and, <u>eventually, another set</u> with different models and set-up, if this leads to <u>better results</u>.**
- **In all cases, the model costant set-up must be specified too**

Tests: spray A

- Densities :
  - 3.8, 7.6, 15.2 and 22.8 kg/m^3 with fuel injection pressure 150 MPa and 900 K temperature.

- Temperatures
  - 700, 900, and 1200 K with fuel injection pressure 150 MPa and 22.8 kg/m^3 density

- Oxygen concentration
  - 0 %

- Fuel injection pressure
  - 50, 100 and 150 MPa with 22.8 kg/m^3 density and 900 K temperature.

<u>Number of required runs: 8</u>

How to submit results

You will be asked to compile a form (groupname_MV4ECN2) and send results in one file for each test case in plain text format in columns with tab or comma delimiters.

The form file will be given in the next days.

To provide your results, you will append to the test case filename the group name and a number indicating the run, for example: testcasefilename_POLIMI_0.txt, where the number 0 is for the “standard" conditions and following numbers are for other possible models which you will specify in your groupname_MV4ECN2 file.

How to submit results

Results file to be provided are:

I) mf: Radial (at x=10 mm, x=25mm, x=45 mm) and injector axial profiles of mixture fraction at steady conditions (defined as fuel vapor mass fraction)
II) mfv: Radial and injector axial profiles at steady conditions of mixture fraction variance

III) Ux, Uy, Uz: velocity components corresponding to the mixture fraction profiles

How to submit results

Results file to be provided are in txt file:

1) At x=10mm at steady conditions

10mm_density_temperature_fuelpressure_O2conc_GROUP_[0-?].txt

In 6 columns:
- radius (mm), mf, mfv, Ux, Uy, Uz

If any of these results is not available please put 0 in the corresponding column

How to submit results

Results file to be provided are in txt file:

2) At x=25 mm at steady conditions

25mm_density_temperature_fuelpressure_O2conc_GROUP_[0-?].txt

In 6 columns:
- radius (mm), mf, mfv, Ux, Uy, Uz

If any of these results is not available please put 0 in the corresponding column

How to submit results

Results file to be provided are in txt file:

3) At x=45 mm at steady conditions

45mm_density_temperature_fuelpressure_O2conc_GROUP_[0-?].txt

In 6 columns:
- radius (mm), mf, mfv, Ux, Uy, Uz

If any of these results is not available please put 0 in the corresponding column

How to submit results

Results file to be provided are in txt file:

4) Along the injector axis at steady conditions

axial_density_temperature_fuelpressure_O2conc_GROUP_[0-?].txt

In 6 columns:
- distance (mm), mf, mfv, Ux, Uy, Uz

If any of these results is not available please put 0 in the corresponding column

Final remark and future steps

This session will be focused at ECN2 only on the spray A tests, while new conditions will be considered after.

In this first call only txt file are required. Contibutors might be asked to provide some images of the entire spray before the meeting.

Similarly, some non-steady results might be asked later depending on the availability of experimental results.

Thank you