Combustion Modeling

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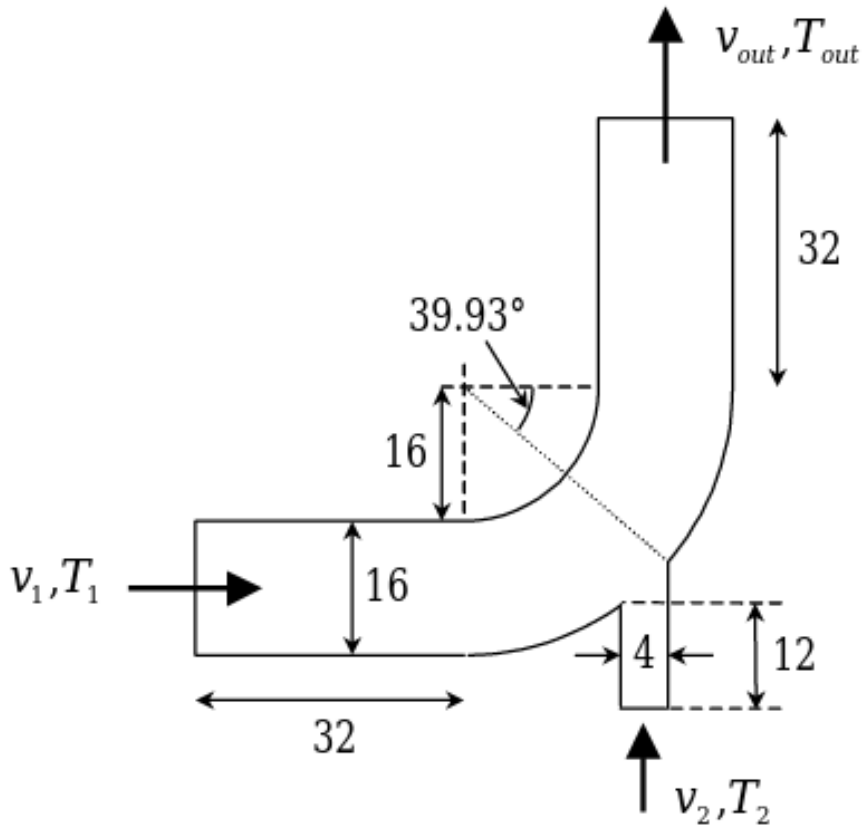
Partially stirred reactor (PaSR) - Background

- Cells splitted in reacting and non-reacting zones
- Reacting zone modelled as perfectly stirred reactor (PSR)
- Reactants assumed as perfectly mixed



Partially stirred reactor (PaSR) - Pre-processing

Set-up the simulation:

- Reaction: $CH_4 + 2O_2 + N_2 \rightarrow CO_2 + 2H_2O + N_2$
- Boundary conditions: "0/" folder (inlet velocities, temperature and species mass fractions)
- Thermophysical properties + Reaction mechanism: "constant/" folder.
- Numerical Settings: "system/" folder.

Convert the mesh

```
$fluentMeshToFoam elbow.msh
```

- Make sure that both "type" and "inGroups" of "frontAndBackPlanes" are defined as "empty" in constant/polyMesh/boundary

Partially stirred reactor (PaSR) - Running simulation + Post-processing

Run the simulation via:

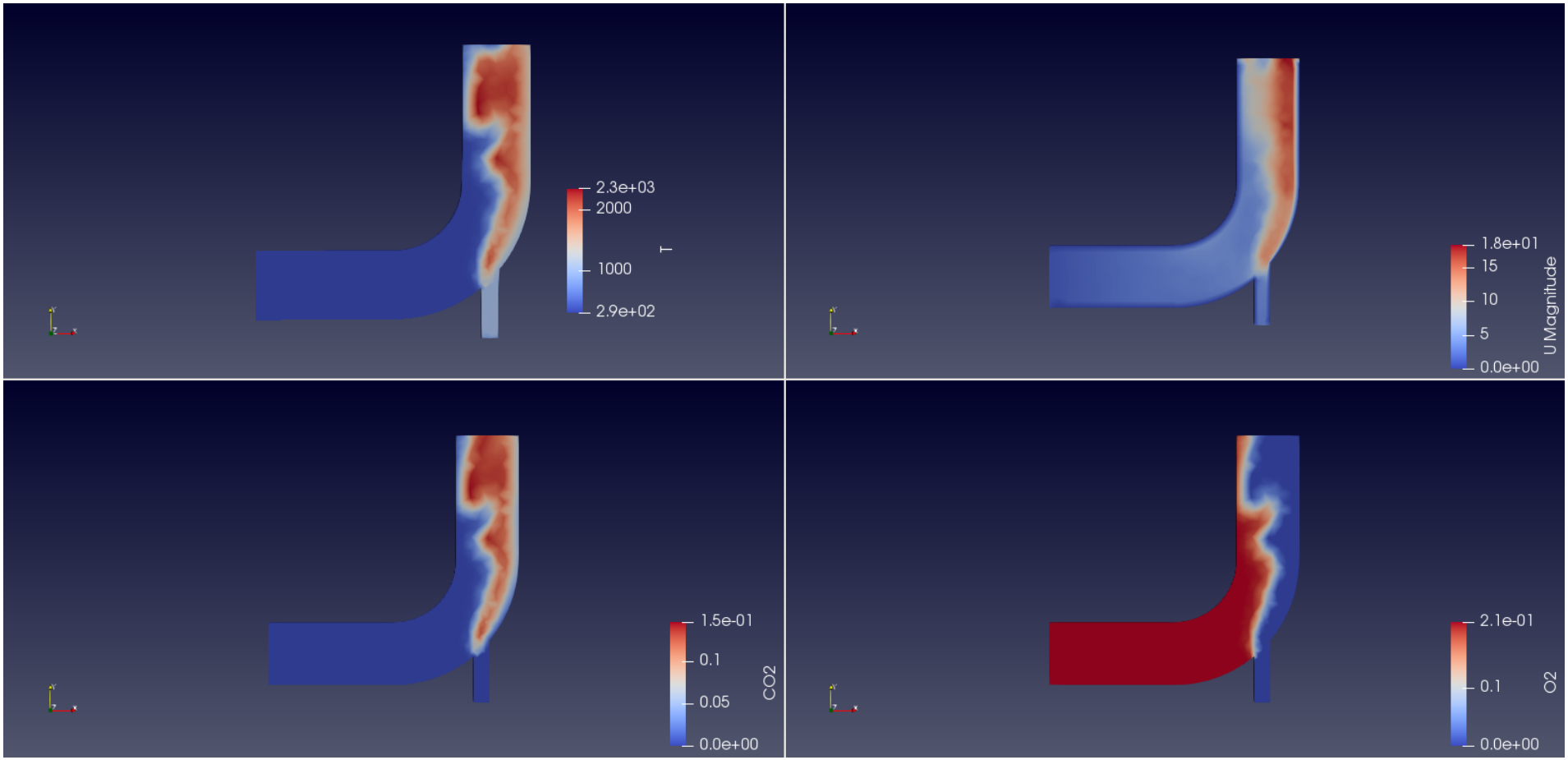
```
$reactingFoam
```

Generate the solution files via:

```
$foamToVTK
```

Open the solution with ParaView.

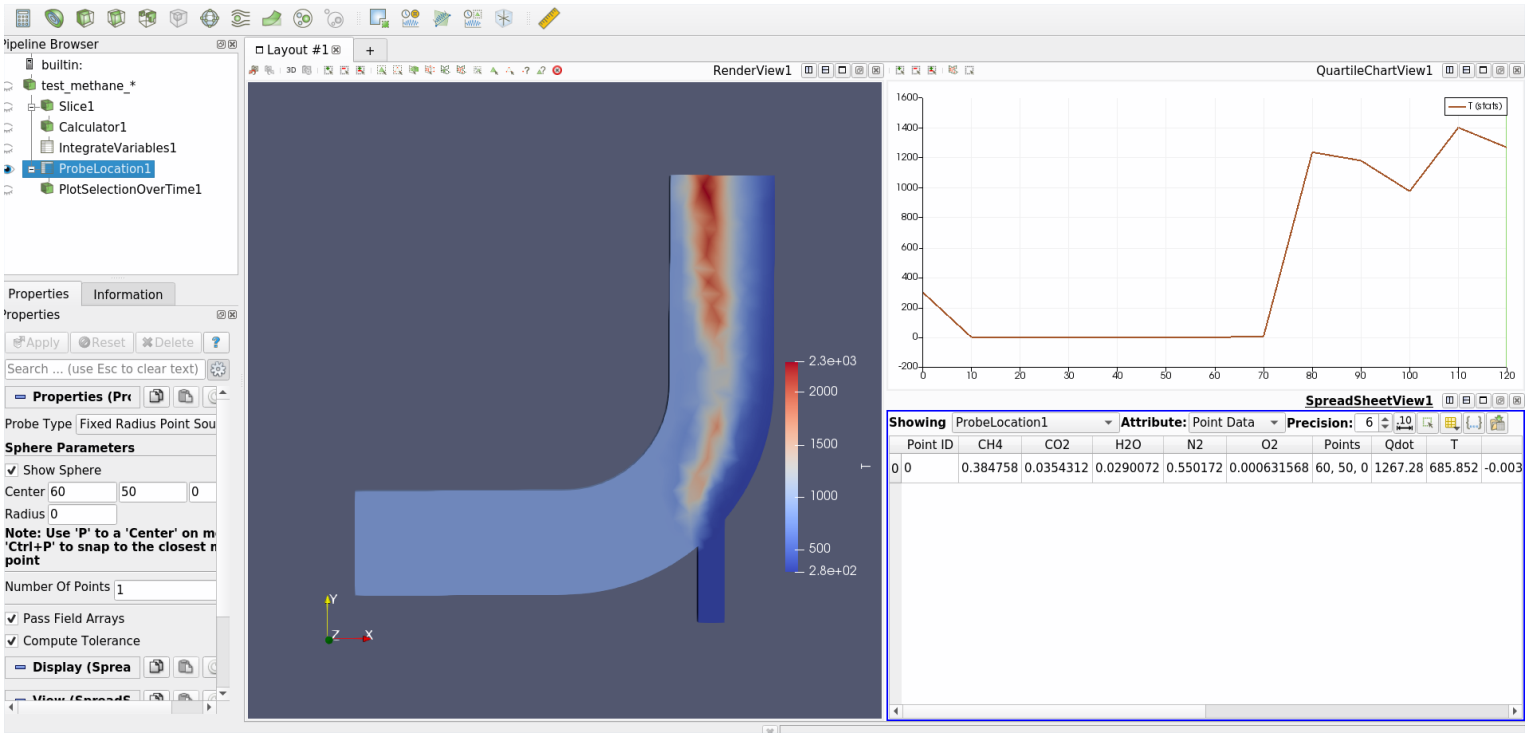
Partially stirred reactor (PaSR) - Solution



Partially stirred reactor (PaSR) - Quantitative Post-Processing

ParaView has some builtin functions that allows to perform some quantitative analysis on your solution.

- Spatial integrals variables over a given section of the domain: $\int_\Omega \phi d\omega$
- Track the time evolution of the variables.
- Calculate User-Defined variables.



Partially stirred reactor (PaSR) - Objectives

For the given Fuel-Oxydizer conditions, by performing different simulations with varying inlet velocities, evaluate (Quantitatively):

- The impact on the outlet gas phase composition.
- The impact on the overall heat released by the reaction.
- The impact on the outlet gas temperature.

Fuel: 50% CH_4, 50% N_2 (Mass Fractions) - T 800 K
Oxydizer: 23% O_2, 77% N_2 - T 293 K
Operating pressure: 1 atm
Operating temperature: 298 K
Adiabatic Walls