Comparisons of the Sydney/Sandia Bluff Body and Swirl Flames

Call for contributions

Invitation

This workshop is an open and ongoing international collaboration among experimental and computational researchers in turbulent combustion. The current emphasis is on fundamental issues of turbulence-chemistry interactions in gaseous flames. Having started with simple jet flames of hydrogen, our attention has moved to flames of simple hydrocarbon fuels (methane, natural gas, and methanol), which include modeling challenges such as local extinction and re-ignition, detached or lifted reaction zones, flow recirculation, and swirl. *from: www.ca.sandia.gov/TNF/abstract.html*

The comparison of theoretical predictions with experimental evidence has been a major aspect of the workshop. These comparisons have allowed to assess progress in modeling approaches and to identify their shortcomings. One important set of target flames for the TNF 8 workshop will be the Sydney/Sandia bluff body and swirl flames, for which a large data-base is maintained by the Sydney group. *www.ca.sandia.gov/TNF/swirlflames.html*
www.ca.sandia.gov/TNF/bluffbod.html

This document aims to encourage you to make a contribution to the upcoming TNF 8 workshop by submitting data for these flames. A comprehensive data bank provided by the Sydney group exists online and will be used for these comparisons.

Producing meaningful comparisons between various submissions is an arduous task given the detailed nature of the calculations. A strict deadline of Just 1st, 2006 is therefor set for submitting your results to A.M. Kempf. The data will then be plotted and compared at Imperial College, preparing the presentation at TNF 8. To facilitate processing of the data, it is critical that contributors follow the directives from this document and submit their results in the requested format. If you are in doubt, please do not hesitate to contact A. M. Kempf.

Authors are invited to submit additional multi-media material like movies, and iso-plots, which will allow for a better insight into their results. Please submit large additional material on CD or DVD to A. M. Kempf.

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Disclaimer

Results in this and other TNF Workshop proceedings are contributed in the spirit of open scientific collaboration. Some results represent completed work, while others are from work in progress. Readers should keep this in mind when reviewing these materials. It may be inappropriate to quote or reference specific statements or results from these proceedings without first checking with the individual authors for permission and for their latest information on results and references.

... this is not a competition, but rather a means of identifying areas for potential improvements in a variety of modeling approaches ...
from: preface to the proceedings of the TNF 6 workshop

Background

The bluff-body and swirl-burners are established model problems for the TNF Workshop Series. Calculations of the structure of bluff-body and swirl stabilized jets and flames are invited for presentation at TNF 8. Interested parties can access the entire data set available on these flows on the websites of the workshop and of the Sydney group. *www.ca.sandia.gov/TNF/swirlflames.html* *www.ca.sandia.gov/TNF/bluffbod.html*

In TNF 4, comparisons were made for the bluff-body cases NRBB and HM1. In TNF 5, HM1e was included. In TNF 7, the focus was hence on these cases, although contributions to HM2, HM3, and HM3e were presented as well. After TNF 6, considerable progress has been made, and the contributions to TNF 8 are expected to show further improvements mainly in the prediction of the chemical state. Contributors are hence encouraged to submit spatial and conditional statistics on temperature and species concentrations, as well as scatter data where appropriate.

For the swirl flow, contributions for the non-reactive cases N29S054, N16S159, and for the flames SMH1 and SMA2, were requested for the TNF 6 and TNF 7 workshop. Contributions to these flames are particularly encouraged. However, a wealth of further flames has been examined and results for other flames will be presented depending on the number of submissions.

Submission

The data submitted should feature at least the averages and fluctuations of velocity, mixture fraction, temperature, and where available, species concentrations. You are encouraged to provide scatter data, iso-plots and additional multi-media material. Contributors should format the output of their calculations as described in this document. (We will not be able to include data that deviates significantly from the formats specified on page 3) Finally, please provide all the information requested on the form (page 4) for each submission. Please add a short description of the models, numerics, tweaks and noteworthy findings as appropriate.

Data to be published in the proceedings of TNF 8 must be submitted no later than June 1st 2006. The deadline for additional multi-media material for the poster session, is July 15th, 2006.

Please inform A.M. Kempf as soon as possible which cases you intend to contribute and whether you are going to provide scatter data, PDFs, or any additional multi-media material.

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Data to be submitted for the bluff body flow

The following table shows the axial positions for which your data should be provided. All the positions are given in terms of DBB, the diameter of the bluff body (50 mm). Please provide a single file for each axial position for velocities and scalars. Please refer to the "Formatting of data" section for detailed instructions.

Table 1: Axial positions for the bluff body flow results

non-reactive case	velocities	0.06	0.20	0.40	0.80	1.40	2.40		
	scalars	0.26	0.60	0.90	1.30	1.80	2.40		
reactive case	velocities	0.06	0.20	0.40	0.60	0.80	1.00	1.20	1.80
	scalars	0.26	0.60	0.90	1.30	1.80	2.40		

Data to be submitted for the swirl flow

The flames of the swirl series vary significantly, so that measurements were taken at various different locations. Please refer to the flame database of the Sydney group to determine the relevant positions. If you intend to submit results for other swirl flows than N29S054, N16S159, SMH1 and SMA2, please contact A.M. Kempf as soon as possible. *www.ca.sandia.gov/TNF/swirlflames.html*

Formatting of data

The preparation of these comparisons requires much effort. For the TNF 7 comparisons, 400 curves were plotted, three posters and a presentation were prepared to allow for an appropriate comparison. For the TNF 8 workshop, the number of contributions is expected to grow further, and hence it is vital that contributors stick to the submission format described below.

It is recommended that you submit a sample plot (Postscript, PDF, GIF, JPEG) of the submitted data, helping us (and you) to spot and to avoid mistakes. Furthermore, you can help by submitting plot-scripts (list of required plot commands) for the free gnuplot program, which will be used to process the data: If you can plot your data using gnuplot, it is formatted appropriately and can be included. If you use non-ISO units, non-standard formats, or variances instead of r.m.s., submitting a gnuplot script is of particular importance! *www.gnuplot.info/download.html*

Please provide separate files for velocities (Reynolds averaged means and r.m.s. in m/s), shear stressses, and files for scalars (Favre averaged means and r.m.s.) at each axial position given in table 1 (for the bluff body flames) or on the Sydney web-site (for the swirl flames). The files must contain plain text, with a header to label the columns. The first column should provide the increasing radial position in [m]. The most relevant information on each file should be copied to its header. Please refer to the following example.

```
Massfractions at x/D = 2.0
Flame SMA1, Contributor X from Impernellft University
1:radius/m    2:CO          3:CO2         4:H2O         5:H2          6:CH4         ...
1.000E-03     x.xxxE+00     x.xxxE+00     x.xxxE+00     x.xxxE+00     x.xxxE+00     ...
2.000E-03     x.xxxE+00     x.xxxE+00     x.xxxE+00     x.xxxE+00     x.xxxE+00     ...
```

Please 'zip' or 'tar' your data into one single file and submit this. Use a separate directory for each simulation and add the description of the case to this directory. Its name should include the abbreviated name of your group, the case investigated, and eventually a label for this submission, e.g. "Standiastadtly.SMH1.a". The filenames should follow the scheme "V0.20D" or "S0.136D" for velocities V or scalars S at the axial position given in bluff-body diameters D. Figure 1 shows an example of this structure.

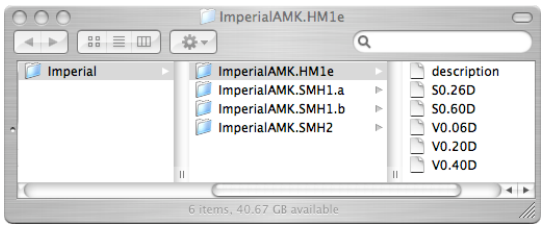

Fig. 1: Directory structure of a contribution.

Thank you for following these conventions, which will allow for an effective and accurate representation of your data!

Finally

The preparation of these comparisons will require much time and effort. To improve the comparison sessions, I will be happy about all kinds of supportive comments, suggestions and constructive critique that aim to improve the outcome of this work. As well, please feel free to contact me if you have any questions about submission, preparation, or anything related to the TNF 8 comparisons of the Sydney/Sandia bluff-body and swirl flames.

I look forward to your submission and to see you in Heidelberg!

Andreas

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Additional information:

Please provide the information requested below in an additional text- or pdf-file "description", using the numbers given in the list below. Alternatively, you can fill in this pdf if your system allows. Please include one such file in each directory you submit. If a question is not appropriate for your approach, please ignore it. Please try to be concise so that the information can be included in the proceedings.

1. Name of contributor _____
2. Name of Institution _____
3. Case investigated _____
4. Chosen approach _____
5. Models used _____

   Type of grid _____
6. Grid-Resolution _____

   _____

   in each dimension, total cells, total particles, cells in jet, bluff-body, annulus
7. Statistics _____

   time-steps, samples, time for initial development, length of sampling period
8. Cost _____

   total CPU hours, number of processors, real time required
9. Numerics: _____

   _____

   type and order of discretisation for convection, diffusion, time-integration
10. Model constants _____

    _____
11. Inflow conditions _____

    _____

    _____
12. Important findings _____

    _____

    _____

    _____
13. Further comments _____

    _____

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    _____

    _____