Journal of Fluids Engineering

Editorial

Editorial Policy Statement on the Control of Numerical Accuracy

A professional problem exists in the computational fluid dynamics community and also in the broader area of computational physics. Namely, there is a need for higher standards on the control of numerical accuracy.

The numerical fluid dynamics community is aware of this problem but, although individual researchers strive to control accuracy, the issue has not to our knowledge been addressed collectively and formally by any professional society of journal editorial board. The problem is certainly not unique to the JFE and came into even sharper focus at the 1980-81 AFOSRHTTM-Stanford Conference on Complex Turbulent Flows. It was a conclusion of that conference's Evaluation Committee[1] that, in most of the submissions to that conference, it was impossible to evaluate and compare the accuracy of different turbulence models, since one could not distinguish physical modeling eerors from numerical errors related to the algorithm and grid. This is especially the case for first-order accurate methods and hybrid methods.

The practice of publishing comparisons based on coarse grid solutions, without systematic truncation error testing, may have been acceptable in the past. Certainly ten to fifteen years ago any calculation was of interest, and much of the exploratory work deserved publication, as many researchers lacked the computational power or funds to do a thorough and systematic error estimation. We are of the opinion that this practice, however understandable in the past, is outmoded and that, with powerful computers becoming more common, standards should be raised. Consequently, this journal hereby announces the following policy:

> *The Journal of Fluids Engineering will not accept for publication any paper reporting the numerical solution of a fluids engineering problem that fails to address the task of systematic truncation error testing and accuracy estimation.*

Although the formal announcement of this journal policy is new, it has been the practice of many of our conscientious reviewers. Thus the present announcement is not a change in policy so much as a clarification and standardization.

Methods are available to accomplish this task, such as Richardson extrapolation (when applicable), calculations with a high- and low-order method on the same grid, and straightforward repeat calculations with finer or coarser grids. As in the case of experimental uncertainty analysis, ". . . any appropriate analysis is far better than none as long as the procedure is explained."[2] Whatever the authors use will be considered in the review process, but we must make it clear that *a single calculation in a fixed grid will not be acceptable*, since it is impossible to infer an accuracy estimate from such a calculation. Also, the editors will not consider a reasonable agreement with experimental data to be sufficient proof of accuracy, especially if any adjustable parameters are involved, as in turbulence modeling.

We recognize that it can be costly to do a thorough study, and that many practical engineering calculations will continue to be performed on a single fixed grid. However, this practice is insufficient for publication in an archival journal.

[1]Emmons, H. W. (Chairman), "Evaluation Committee Report," pp. 979-986 in *Proc. 1980-81 AFOSR-HTTM-Stanford Conference on Complex Turbulent Flows*, Vol. II, "Taxonomies, Reporter's Summaries, Evaluation, and Conclusions," Thermosciences Division, Mechanical Engineering Department, Stanford University.

[2]Kline, S. J ., "The Purposes of Uncertainty Analysis," ASME JOURNAL OF FLUIDS ENGINEERING, Vol. 107, June 1985, pp. 153-164.

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