

# Accepted Manuscript

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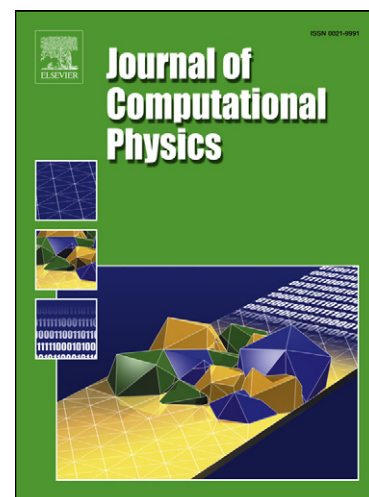
PII: S0021-9991(15)00802-5  
DOI: <http://dx.doi.org/10.1016/j.jcp.2015.11.054>  
Reference: YJCPH 6271

To appear in: *Journal of Computational Physics*

Received date: 31 October 2014  
Revised date: 27 October 2015  
Accepted date: 26 November 2015

Please cite this article in press as: W. Rider et al., Robust verification analysis, *J. Comput. Phys.* (2015), <http://dx.doi.org/10.1016/j.jcp.2015.11.054>

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# Robust Verification Analysis

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## Abstract

We introduce a new methodology for inferring the accuracy of computational simulations through the practice of solution verification. We demonstrate this methodology on examples from computational heat transfer, fluid dynamics and radiation transport. Our methodology is suited to both well- and ill-behaved sequences of simulations. Our approach to the analysis of these sequences of simulations incorporates expert judgment into the process directly via a flexible optimization framework, and the application of robust statistics. The expert judgment is systematically applied as constraints to the analysis, and together with the robust statistics guards against over-emphasis on anomalous analysis results. We have named our methodology Robust Verification.

Our methodology is based on utilizing multiple constrained optimization problems to solve the verification model in a manner that varies the analysis' underlying assumptions. Constraints applied in the analysis can include expert judgment regarding convergence rates (bounds and expectations) as well as bounding values for physical quantities (e.g., positivity of energy or density). This approach then produces a number of error models, which are then analyzed through robust statistical techniques (median instead of mean statistics).

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<sup>1</sup>Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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