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GUIDE FOR THE VERIFICATION AND VALIDATION OF COMPUTATIONAL FLUID DYNAMICS SIMULATIONS

A review by Francesca Iudicello
ESDU - IHS

This guide was developed by the Computational Fluid Dynamics Committee on Standards of the American Institute of Aeronautics and Astronautics (AIAA). It is the synthesis of the published literature prior to 1998 on verification and validation (V&V) in CFD modelling and simulation.

The guide is aimed at providing support to researchers, developers and CFD users by establishing a common basic terminology and methodology for V&V of CFD simulations. It is not intended for certification or accreditation of CFD codes.

Verification and validation are the two main processes for assessing the credibility of modelling and simulations in CFD. In this guide, the fundamental strategy for the identification and quantification of the accuracy of the CFD solutions in terms of "uncertainty" in the modelling process and in terms of acknowledged and unacknowledged "errors" is provided. Definitions of key terms and processes help the reader indentify the causes for the uncertainties and errors of CFD simulations and hence develop a procedure to reduce those. It is emphasized that there is no fixed level of credibility or accuracy that is applicable to all CFD simulations as this depends upon the purpose for which the simulations are to be used. Some useful sketches help understand process stages and interactions.

A number of key terms and processes in CFD verification and validation are defined and discussed in detail. These include:

model	validation	uncertainty	grid and time-step convergence
modelling	verification	error	iterative convergence
simulation	calibration	prediction	consistency checks
	benchmark solutions		highly-accurate solutions

General procedure for CFD verification and validation are provided. These can help experienced CFD users setup V&V procedures for specific applications which can, for example, be used by less experienced users to assess and improve confidence in CFD simulations and predictions.

The various phases of the validation processes are described and the different levels of assessment for accuracy are discussed. The reader can use this information in setting up an experimental test for CFD validation or break down a complex flow problem in sub-problems of lower complexity using a building-block approach.

A list of 105 references is provided on the various V&V issues and on highly-accurate CFD Benchmark Cases.