Experience in Developing the “AIAA Guide for the Verification and Validation of Computational Fluid Dynamics Simulations”

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Presentation for:
ad hoc Committee on Verification and Validation
United States Association for Computational Mechanics
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Outline of Presentation

• Background Information
• Elements for success
• Recommendations
AIAA Standards Committees

- 20 AIAA Committees on Standards
- Supervised by the AIAA Standards Executive Council
- AIAA Standards Program is accredited by the American National Standards Institute (ANSI)
- Three levels of standards documents:
  - Guide
  - Recommended Practice
  - Standard
- All documents are advisory only; not legally binding
- Standards documents are separate from journal and conference paper publication requirements
AIAA Computational Fluid Dynamics Committee on Standards

- CFD COS was formed in 1987
- Committee membership:
  - 15 - 20 members serve voluntarily
  - Members from industry, government, and academia
- Committee Chairs:
  - 1999 - present: Raymond Cosner, Boeing/St. Louis
CFD COS Project:
Assessment of Accuracy of CFD Simulations

- Project begun in 1992

- Purpose of project:
  - To promote the establishment of basic terminology and methodology for assessment of accuracy of CFD simulations.

- Debated issues from 1992 to 1996:
  - Terminology
  - Verification and validation methodology and procedures
  - Concerns of industry that document could be used as a “club”

  - Prepared by: Unmeel Mehta, NASA/Ames Research Center
  - Failed committee vote in June 1997
CFD COS Project: (continued)
Assessment of Accuracy of CFD Simulations

• New volunteer June 1997: Bill Oberkampf
• Asked two other committee members to put new draft together:
  • Munir Sindir, Boeing/Canoga Park
  • Terry Conlisk, Ohio State University
• New draft prepared and sent to members for vote in December 1997
• New draft passed committee in January 1998
• Incorporated committee comments and comments from others
• Published in June 1998:
  “Guide for the Verification and Validation of Computational Fluid Dynamics Simulations” (AIAA G-077-1998)”
Elements for Success: Committee Membership

• Diverse representation is needed:
  • Industry, government, and academia
  • Computationalists and experimentalists
  • Researchers, applications analysts, and software developers
  • Engineering staff and management
• Experience in V&V is desirable, but not necessary
Elements for Success: V&V Document Preparation

- Draft document should be prepared by a small team:
  - 2 - 4 individuals
- Team should be composed of diverse viewpoints:
  - Industry, government, academia, analysts, experimentalist, code developer
- Team members, especially the team leader, must be:
  - Flexible in their viewpoint and willing to compromise
  - Willing to devote significant time and effort
- A cohesive, resolute, team is critical

Comparable to writing an article for Annual Reviews, but you must satisfy 25 reviewers.
Elements for Success: Administrative

- Committee must be part of an ANSI approved Standards Program.
- Early drafts of the V&V document should be discussed and debated, but not voted on.
- At the appropriate time, a formal vote must be taken.
- Rules for voting:
  - A negative vote must be accompanied by detailed criticisms
  - A positive vote may include recommendations for changes
  - The vote of the committee must be near unanimous
Recommendations: Technical

- Using the AIAA Guide as a basis, expand to solid mechanics/dynamics

- Topics in need of debate/development/extension:
  - Terminology (e.g., uncertainty, error, prediction)
  - Detailed verification assessment procedures (e.g., quantification of numerical error, high accuracy solutions for solid mechanics/dynamics)
  - Detailed validation assessment procedures (e.g., construction of validation levels, statistical quantification of validation comparisons, design and execution of validation experiments)
  - Attain a good balance between solid mechanics and solid dynamics

CAUTION: Don’t try to do everything!
Recommendations: Administrative

- Have our *ad hoc* committee join/merge with the Standards Program committees of:
  - ASME or ASCE or AIAA

- Committee membership:
  - Expand to about 20 to 25 interested members
  - Improve the depth of representation of diverse viewpoints
  - Keep membership emphasis on solid mechanics and solid dynamics