USACM STUDENT BENCHMARK COMPETITION

Sponsored by

United States Association for Computational Mechanics

and

ASME Committee on Verification & Validation in Computational Solid Mechanics

Introduction

The American Society of Mechanics Engineers, Council on Codes and Standards, Performance Test Codes Board, Committee on Verification and Validation in Computational Solid Mechanics (PTC #60) has set itself the task of collecting and recommending a suite of analytical benchmark solutions that can be used in verifying numerical algorithms (codes). The goal is to select *quality* benchmark problems that will verify codes in non-trivial ways. The benchmark problems should be of engineering interest and possibly contain aspects that might present pitfalls for inadequately implemented numerical algorithms.

USACM and the ASME Standards Committee, PTC #60, have agreed to sponsor a Student Benchmark Competition in association with the USACM's 7th National Congress, to be held during 27 – 31 July 2003 in Albuquerque. Briefly, the competition consists of soliciting original student benchmark works, judging of the submissions by members of the ASME PTC #60, and award of travel grants by USACM to selected contributions for attending the 2003 National Congress and presentation of the work in a special symposium organized by the Verification & Validation Committee.

Background

For the purpose of this competition, Benchmarks are considered to be analytical solutions suitable for use in verifying computational algorithms. The focus is on determining if the numerical algorithm has been implemented correctly, i.e. verification – are the equations being solved correctly?

As an example, consider a numerical analysis code, e.g. finite element code, that offers a beam element. The associated code documentation describes this beam element as being based on traditional Bernoulli-Euler beam theory. The associated Benchmark activity would be to review Bernoulli-Euler beam theory, its assumptions and limitations. Then develop an analytical

solution for a particular problem, or better a suite of problems, where the assumptions and limitations of the theory can be demonstrated and assessed. Next, these demonstrative analytical problems are appropriately modeled using the numerical analysis code, and detailed comparisons are made between the analytical and numerical solutions, with an emphasis on determining if the Bernoulli-Euler beam theory was correctly implemented in the numerical analysis code. Note the emphasis on exercising the code with Benchmarks where things can go *wrong*, as it is the limits, or bounds, on the algorithm where careful examination is required, i.e. it is assumed relatively trivial problems are adequately treated by the algorithm.

Elements of a Benchmark Competition Submission

Each benchmark case should include:

- A detailed problem description, including governing equations, boundary conditions, and limitations of the theory used along with citations of the original and any associated work.
- An analytical solution and its implementation in a form that can be readily used by others, e.g. a Mathematica Notebook or self contained computer program.
- Verification of the analytical solution via comparisons with published results.
- A numerical simulation implementation in the form of a complete input file for a major commercial analysis code.
- A detailed description of the numerical simulation implementation with sufficient modeling detail that other analysts can implement the numerical simulation using other numerical analysis codes.
- A detailed description of the verification of the numerical solution via comparisons with the analytical solution, and appropriate published results.

Judging and Awards

All entries will be judged by members of the ASME Verification & Validation Committee. Each entry will be provided an anonymous critique, similar to the peer review of a journal publication. The Committee will recommend to USACM a prioritized list of the number and distribution of travel grant awards. Within its travel grant budget, USACM will award travel grants intended to cover the cost of travel to the Congress, and appropriate expenses while attending the Congress. In addition USACM will waive the Student Registration fee for those selected to receive travel grants.

A special Congress session will be organized by the Verification & Validation Committee for presentation of selected Benchmark submissions.

Submission Deadline for Entries

All entries must be received by Friday April 11, 2003. It is anticipated that travel grant awards will be announced by USACM by Friday May 15, 2003.

Submit entries to:

Professor JN Reddy
USACM Benchmark Competition
Texas A&M University
Dept. of Mechanical Engineering
ENPH Building, Room 210
COLLEGE STATION TX 77843-3123

The rights to publish, and distribute, all entries will be transferred to the ASME Verification & Validation Committee. The Committee intends to promote this activity in other forums, and with proper attribution to the contributing authors, the Committee may publish or further distribute the entries.

Eligibility

The competition is open to students and young researchers, i.e. defined as those who have earned their Ph.D. within the past 2 years. Team submissions by students, and student organizations, are encouraged, but not all members of selected team submissions may be offered travel grants.

Questions and Comments

Questions and comments concerning the Benchmark Competition can be directed to the competition co-organizers:

Professor JN Reddy
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(979) 862-2417

or

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