DEVELOPMENT OF AN UNSTRUCTURED 3D FINITE VOLUME ALGORITHM (FVM) FOR THE SOLUTION OF A NEW CONSERVATION LAW FORMULATION IN STRUCTURAL DYNAMICS

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RESEARCH PROJECT SUMMARY
Development of a new FVM algorithm for a new mixed conservation law formulation for structural dynamics, to improve the accuracy and alleviate the conventional problems of standard FEM formulations.

OBJECTIVES FOR THE CURRENT PERIOD
- Literature review on unstructured FVM and Nonlinear Continuum Mechanics
- MatLab implementation of a 1D-FVM solver
- Convergence-stability analyses
- Familiarisation with in-house 2D software

RESEARCH ACTIVITIES

Review of the basic formulation
- Why using two different equations?
- Why in a conservation law format?
- Which numerical methodologies can be used?

Review of FVM technology and basic implementation
- How do FVM methods work?
- What is a Riemann Solver (RS)?
- How to combine spatial reconstruction and time integration?

Implementation of 2nd order vertex centered 1D FV algorithm for irregular meshes using RS
- Linear reconstruction and slope limiters
- Barycenter ≠ node: how to calculate slopes?
- Nodes @ boundaries: weak BC, strong BC or both?

Analysis of results and convergence
- Convergence depends on smoothness?
- Analytical solution not always known: how to compute error (i.e. $L_1$, $L_2$, $L_\infty$ norms)?

CONCLUSIONS AND OBJECTIVES FOR THE NEXT PERIOD

Conclusions
- Method works as expected (1D irregular and regular meshes)
- Computational cost affordable for 1D problems, maybe too high for 2D and 3D unstructured meshes (i.e. MatLab and Riemann solvers).
- Results sensitive to BCs

Objectives
- Application to 2D unstructured meshes
- Use of in-house CFD technology
- Application to large deformations and plasticity problems
- Numerical implementation of involutions

MatLab implementation of a 1D-FVM solver
Convergence-stability analyses
Familiarisation with in-house 2D software