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| **Verification type** | Analytical Solutions |
| **Database reference** | ANA-5 |
| **Topic / Application** | Analytical Solutions (1-D semi exact)<br>Manufactured Solutions |
| **Physics** | Compressible flows<br>Sedov blast wave Problem<br>Riemann Problem<br>Taylor Green Vortices |
| **Summary** | Verification results for a three-dimensional unstructured finite element method have been presented. Accuracy and convergence measurements were given for both shock-dominated and smooth flows. |
| **Description** | The paper presents a range of verification tests and results on a three-dimensional unstructured finite element CFD code. CHICOMA. The code is applied to highly compressible flows, and so has relevance in to the hydrogen community in terms of blast wave propagation.<br>Analytical solutions for the Riemann and Sedov blast wave problems are presented, as well as a Manufactured solution for representing Taylor Green Vortices.<br>Formal accuracy is demonstrated using error norms based on the density field. |
| **Case Title** | Verification of a three-dimensional unstructured finite element methodusing analytic and manufactured solutions |
| **Authors** | J. Waltz et al |
| **Year** | 2013 |
| **Online reference** | Computers & Fluids 81 (2013) 57–67 |

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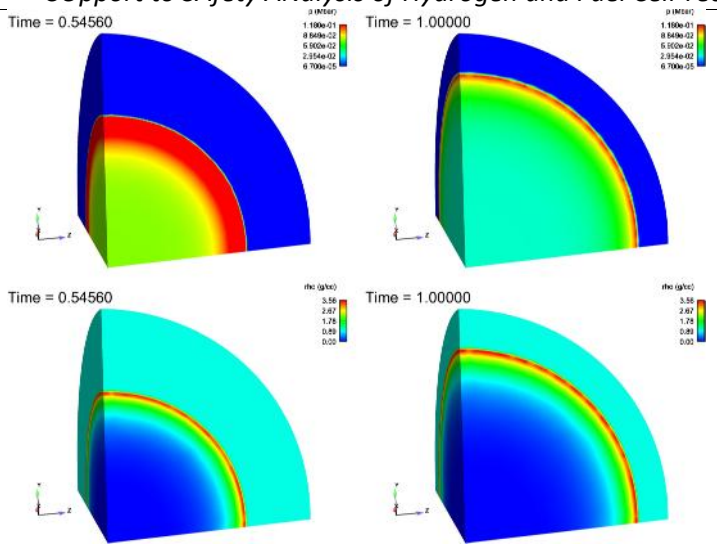
| **Case image** |  <br>Surface pressure and density for the Sedov problem at t = 0.5 us and t = 1.0 us on finest mesh |
| **Governing equations** | |
| **Results** | The paper demonstrates a formal order of accuracy above 2 is generated. This is higher than the expected level of 2. The authors identify the reason being due to some pathologies in the tetrahedral grid and in the use of the error norm which is global rather than local. |

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