Discontinuous Galerkin implementation with hpGEM

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ABSTRACT

We have seen a fast growth in interest during recent years to theoretical development and application of discontinuous Galerkin finite element methods (DGFEM) to a broad range of problems. This type of finite element methods permits the functions to be discontinuous across the boundaries between elements. The advantages of such discretizations include the possibility to incorporate *h*- and *p*-adaptation, and unstructured meshes. However, implementation of DGFEM schemes is a challenge and relies on the mathematical and software skills of a developer.

The hpGEM package [1], a software framework for DGFEM, makes implementation of DG schemes become relatively easy. The package was developed using object-oriented software development approach and was written in C++. Several application of physics problems ranging from fluid mechanics to electromagnetism have so far been built using hpGEM (see Figure 1 for an example).

In this paper we present the architectural aspects of the package that makes it suitable for a wide range of applications. We will also discuss performance and data structure regarding its future development to support *hp*-adaptation as mentioned in [2].

REFERENCES

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[2] W. Bangerth and O. Kayser-herold, Data Structures and Requirements for hp Finite Element Software, *ACM Trans. on Math. Soft.* Vol. 36, No. 1 (2009).

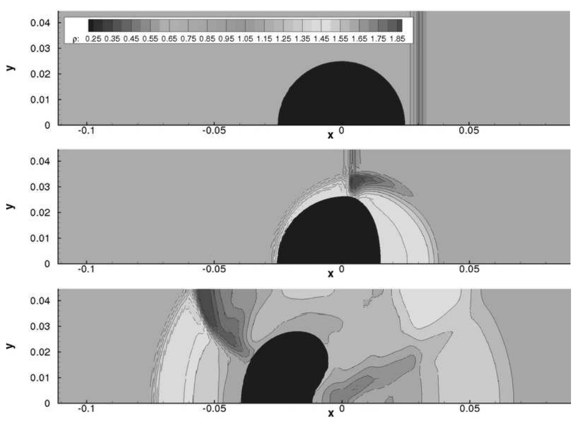

Figure 1: Helium bubble in ideal gas being struck by a Mach 1.22 shock wave. *Courtesy*: W.E.H. Sollie.