Capabilities and Applications of the GasDynamicsTool 5.5 Parallel Version

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One of the most significant and crucial aspects of building program systems is the problem of computations parallelization and distribution. Recently, due to the progressing development of multi-processor technologies the problem of parallelization has become yet more topical. Among the basic fields where parallel processing technologies find application are multi-dimensional problems in continuum mechanics, in particular – numeric modeling of gas-dynamic processes. Implementation and testing procedures for the approaches described herein are based on the package GasDynamicsTool 5.5.

The authors of this package have designed an efficient multi-platform technology for computation procedures dynamic parallelization, which relies on the use of novel approaches to computations synchronization management. A high processor utilization factor has been achieved. Thus, for a double-processor PC this factor reaches a figure of 0.96 – 0.98.

This technology has been implemented on the platforms Windows and Unix (Linux, Solaris) in an SMP version. Implementation on the Unix platform conforms to the POSIX standard requirements, which makes the technology usable on diverse computer platforms.

In the Unix version there has also been realized for cluster approach, which makes it possible to use all the accessible cluster nodes as well as all the processors available on each node.

This approach makes it possible to handle objects with dynamically changing properties, among other things diverse geometry objects, periodical sources of energy, variable boundary conditions, etc. Solving this kind of problems has traditionally presented difficulty regarding inter-processor data exchange.

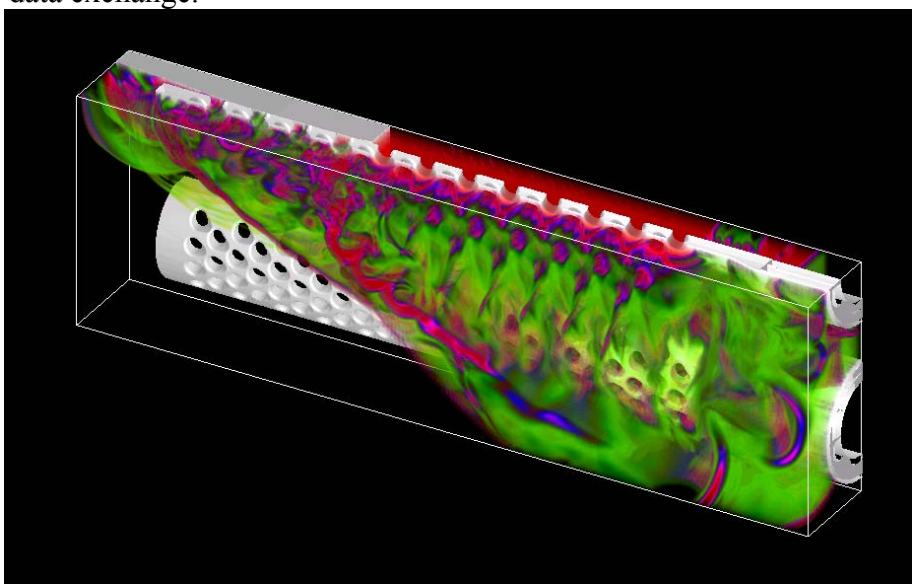

Fig. 1: Pressure distribution for a projectile exiting the muzzle of a twin-barrel gun system.

Fig.1 shows a sample package application for a projectile exiting the muzzle of a twin-barrel gun system. The geometry was imported from a CAD system. Precise definition of this geometrical pattern requires a large number of cells, 60 million cells in the given case. The com-

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putation run lasted 21 hours on two cluster nodes, each being a double-processor PC on Athlon XP 1800+ CPU's. 2 500 steps were computed with a computation time for one step of approximately 30 seconds.

The dynamic variability of problem configuration presents additional difficulty in parallel computations, especially for systems with distributed memory.A particular example of a dynamically variable configuration is the presence of moving objects in the computation domain. In the case problem described here it is a projectile traveling at a constant speed.

Visualization was accomplished with the help of the Scientific VR package developed by GDT Software Group and based on semi-transparent voxel graphics technique. The Scientific VR program is an integral part of the package GasDynamicsTool 5.5.

This paper presents comparative data on package application for various operational systems and hardware platforms. Program performance versus cluster node number and other characteristics are presented in the topic.