NUMERICAL SIMULATION OF SOME COMPLEX COMBUSTION AND DETONATION PROBLEMS AND FEATURES OF THE OBTAINED DATA VISUALIZATION

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Research of acts of terrorism and failures on industrial objects have become more frequent recently and are attributes of any work providing human safety. These phenomena are frequently accompanied by different energetic materials combustion and detonation processes. It is necessary to conduct exact and efficient numerical simulation to successfully analyze different energetic materials. The article exemplifies numerical simulation of combustion and detonation complex processes by means of GDT software package. This software package is used to solve problems of viscous and non-viscous gas flows in the presence of diffusion, thermal conduction, chemical reactions (including combustion and detonation) and external power supply. One should also take into consideration presence of moving solid bodies. The software package enables to precise simulate high explosives charge detonation, low density explosives, fuel air explosives and two-phase charges with metal particles.

The obtained intermediate and final data are to be processed. One of the data processing methods is visualization. Various graphic presentations considerably simplify data block perception by human brain. This is very important when processing large 3D data arrays dealt with in the course of numerical simulation of combustion and detonation processes, especially when multiprocessor computer systems are used. For example, all the results given in the article were obtained by means of those systems. Intermediate and final data volume reached tens of gigabytes. Graphic processing of such data volume brings about huge amount of computing resources. Implementation of “on-the-fly” dynamic visualization involves additional difficulties. Nevertheless, it is this very visualization type that offers researchers most possibilities – to observe the simulated processes and analyze the obtained data immediately in the course of computation that makes the phenomena under research more clear, especially when one deals with such complex processes as detonation and combustion. Moreover, this visualization type allows promptly detecting errors made at the project development stage or revealing the necessity to adjust the model itself for a more adequate representation of real processes.

Thereby, development of the software package used on different distributed computer systems with a random user’s application that effects dynamic visualization of the data obtained from multiprocessor

computer systems immediately in the course of computation as well as visualization of huge data amounts (100 GBytes - 1 TByte and more) with its simultaneous display in various representations (coordinate and functional transformations included) is quite an issue of the day.

The article deals with some general problems arising from this software package development, ways of their solving as well as an example of development this software package on the basis of the Scientific VR, developed by GDT Software Group.

Keywords: Gas Flow, Simulation, Combustion, Detonation, Visualization