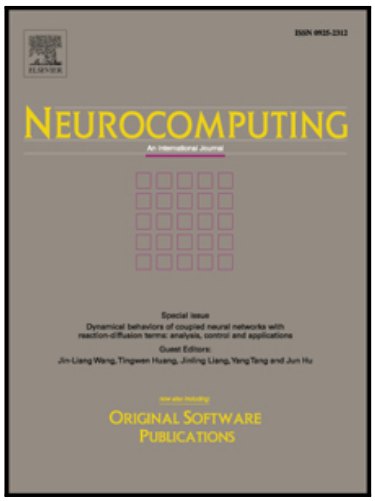

GVM Based Intuitive Simulation Web Application for Collision Detection

Binbin Yong, Jun Shen, Zebang Shen, Huaming Chen, Xin Wang, Qingguo Zhou

PII: S0925-2312(17)31782-4
DOI: 10.1016/j.neucom.2017.05.107
Reference: NEUCOM 19088

To appear in: *Neurocomputing*

Received date: 29 October 2016
Revised date: 15 May 2017
Accepted date: 31 May 2017

Please cite this article as: Binbin Yong, Jun Shen, Zebang Shen, Huaming Chen, Xin Wang, Qingguo Zhou, GVM Based Intuitive Simulation Web Application for Collision Detection, *Neurocomputing* (2017), doi: 10.1016/j.neucom.2017.05.107

GVM Based Intuitive Simulation Web Application for Collision Detection

Binbin Yong[a], Jun Shen[b], Zebang Shen[a], Huaming Chen[b], Xin Wang[a], Qingguo Zhou[a,*]

[a]*School of Information Science and Engineering, Lanzhou University, Lanzhou, Gansu, China*
[b]*School of Information Systems and Technology, University of Wollongong, NSW, Australia*

Abstract

Computer simulation, which has been proved to be an effective approach to problem solving, is nowadays widely used in modern science. However, it requires a lot of computing resources, which are difficult for general users to acquire. In this paper, we design a Web based system to implement on-line simulation system for ordinary users. As a useful example, the simulation of one type of collision detection model is presented in this paper. Moreover, the software application of simulation is offered as a service on Web. Meanwhile, the incorporation of general vector machine (GVM, a type of neural network) to intelligently predict the relationship between simulation parameters and computation resources is presented, which could further provide more information for system monitoring and scheduling. The system has demonstrated efficiency and intuitiveness for users of this type of applications.

Keywords: computer simulation, Web, collision detection, GVM

1. Introduction

With the rapid development of graphics processing unit (GPU) technology, realistic high performance computing systems become more powerful, and at the same time, more complex. For example, in the research field of nuclear simulation, we need to simulate the collision between various particles and different walls. In the field of particle accelerator field, the accelerated particles collide with other particles or the irregular wall. One of the most important factors to generate this type of simulative physical systems is to realize collision detection, especially when vessels are irregular. The term *irregular vessel wall* is the container used to store the particles to be accelerated and collided. In this paper, it is equivalent to *irregular object*, *object*, *wall*, and *model*.

Limited to the computing ability, traditional algorithms could only simulate collisions of tens of thousands particles. The reason was that with the growth of the particles number, the cost of computing would increase exponentially. Nowadays, GPU is more widely used in simulating computation to accelerate this type of simulation for its parallel property. In this paper, we design an algorithm to implement the collision detection between the particles and irregular walls. These particles are generally considered as spheres. Firstly, we divide the wall into small triangles that are surrounded by spheres. And then we make collision detection between these spheres and particles in parallel by utilizing GPU and space subdivision.

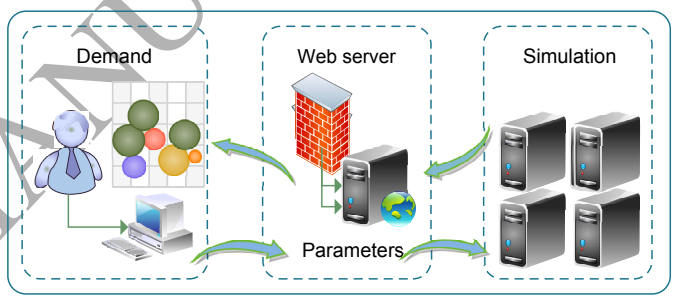

Fig. 1. Web-based simulation platform.

At the same time, as shown in Fig. 1, we implement a Web based platform to provide on-line simulation. Users will be able to share their simulation results and computation resources in this platform. The whole system is efficient and intuitive to end users who have a vision to share or present the simulations of large scale physics experiments. The computation resources of new simulation task is predicted by an artificial neural network (ANN) based general vector machine (GVM), which is instructive for resources scheduling.

The rest of this paper is organized as follows. Section 2 reviews the basic concepts and prior work. We present our design and implementation of the collision algorithm in Section 3. Section 4 shows the design of the Web simulation service. In Section 5, we firstly present the experimental results of the collision algorithm, then give the analysis of our Web based system. The effects of different parameters on the algorithm are discussed. At last in Section 6, we conclude our research and address the future work.

*Corresponding author at: School of Information Science and Engineering, Lanzhou University, Lanzhou, China. Tel: +86-0931-8912025; Fax: +86-0931-8912025

Email addresses: yongbb14@lzu.edu.cn (Binbin Yong), jshen@uow.edu.au (Jun Shen), shenzb12@lzu.edu.cn (Zebang Shen), hc007@uowmail.edu.au (Huaming Chen), xwang2016@lzu.edu.cn (Xin Wang), zhouqg@lzu.edu.cn (Qingguo Zhou)