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A Collaborative Simulation Framework based on Distributed Computing Environment

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Abstract

Large-scale complex system modeling and simulation involves multidisciplinary knowledge. It is usually necessary to create models using different modeling languages and methods. Therefore, a simulation system built by these models has the characteristics of heterogeneous and hierarchical structure. It will be a great challenge in designing and controlling simulation execution. This paper proposed a hierarchical modeling method and designed a synchronous control algorithm based on synchronous points array. Then we implemented a collaborative simulation framework based on distributed computing environment. The result illustrates this framework provides an efficient mechanism to support hierarchical modeling. With the rate of computing load to communication load increasing, the parallelism will be higher, thus the performance of the simulation system can be promoted.

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Keywords: distributed computing environment, simulation framework, hierarchical modeling method, synchronous control algorithm

1. Introduction

Collaborative simulation is a simulation technology which organizes varied models to work together for analysis and evaluation. The models are usually located in different geographical areas, based on different computer systems, or built with different modeling languages and different modeling tools [1, 2]. The main idea of collaborative simulation is to solve simulation problems within the course of designing complex

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systems [3]. Although some existing simulation tools, to some degree, can solve most analysis and evaluation issues of complex systems in single domain, they lack the support for complex system simulation in multidomain [4]. With the increase of sophistication and complexity within complex systems, it is difficult to solve the problem only use one kind of simulation tools [5]. Therefore, collaborative simulation technology for complex system simulation in multidomain becomes an important trend [6, 7].

Recently, a collaborative simulation system often combines hydromechanics, aerodynamics, mechanical control models to achieve united simulation. It involves various computing models with multidisciplinary knowledge [8]. Besides, each computing model is developed using various modeling languages and simulation tools. As a result, the simulation system composed of those models has the characteristics of heterogeneous and hierarchical [9, 10]. It brings a great challenge in the design and corporative control of simulation systems. To solve this problem, the paper proposed a collaborative simulation framework based on distributed computing environment. The results illustrate this framework provides an efficient mechanism to support hierarchical modeling. Moreover in the distributed computing environment, the performance of the collaborative simulation system can be improved.

The remainder of this paper is structured as follows: in section 2 we explain our collaborative simulation framework in detail. In section 3 we give the analysis with experiment. Finally, our conclusion will be made with an indication of the future work.

2. Collaborative simulation framework

This paper has first studied the key technologies of collaborative simulation, then designed and implemented a collaborative simulation framework which is based on distributed computing environment. Computer nodes are classified as a simulation control node and several computing nodes in our framework. Each computing node contains at least one computing model. Computing models run on computing nodes and pass output parameters, status information to the simulation control node though TCP/IP protocol. In the running, the simulation control node receives output parameters and model status from the previous computing model, then passes input parameters to next computing model and schedules it to run. The collaborative simulation framework shows as figure 1.

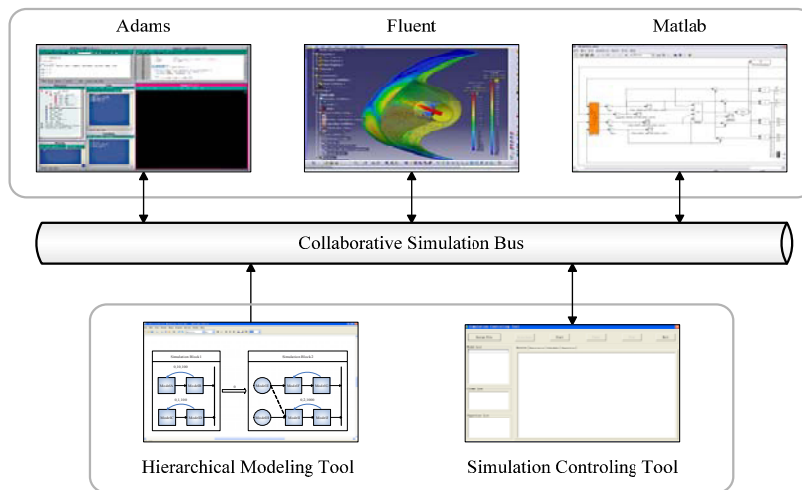


Fig. 1. The collaborative simulation framework

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