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Navigation System Volume Simulation based on DPSSF

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Abstract

To resolve the model integration problem in Navigation System Volume Simulation (SVS), A distributed & parallelized simulation framework based on Simulation Model Portability (SMP2) and Service-Oriented Architecture (SOA) is promoted. The SVS and its main criterions are introduced and then a simulation SVS model framework is propounded. The distributed & parallelized SMP2 simulation framework based on SOA (DPSSF) is detailed. At last, a example of global or regional visibility analysis is given to show how the DPSSF is used in SVS.

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Keywords: SVS; SMP2; SOA

1. Introduction

Simulation Analysis and Evaluation system of satellite navigation system's service performance on Positioning, Velocity-measuring and Timing plays an important role in the construction of satellite navigation system.

Simulation Analysis and Evaluation system of Satellite navigation system is a large scale complex system, there are many characteristic about this kind of system compared to simple systems:

1) The system development involves many organizations which belong to different county and region or different domain and department.
2) The whole system would be divided to many sub-systems, which be distributed to different organizations to develop.

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3) Every organization have their own methods, techniques, standard and tools to design, analysis, evaluate and implement the sub systems.
   So, the model integration in construction of these complex systems becomes very complicated.
4) In the conceptual level, these models were developed by different organizations through different modeling paradigm, it's hard to achieve common concept and understanding among the model developers and integrators.
5) In the implementation level, these models were developed by different organizations through different computer platforms and programming languages, it's hard to select a foundational technique platform to integrate all the models together.
6) In the communication level, these models may be distributed in different regions of the world. A distributed model integration method could greatly decrease the difficulty and workload of the whole system development.

To resolve the aforementioned problems, two issues should be considered: model standard and simulation system architecture.

Simulation Model Portability 2 (SMP2)[1][2][3] is propounded by European Space Agency (ESA) in 2004. Its purpose is to meliorate the portability, maintainability and reusability of the simulation models. SMP2 assimilates the advantage of Component-based Design (CBD) and Model Driven Architecture (MDA), accepts the open standard as United Modeling Language (UML) and Extensible Markup Language (XML), finally provides a model development framework, and related tools.

In recent years, Service Oriented Architecture (SOA) and Web Service technologies have been well studied to improve the distributed computing. SOA, which integrates the existing service to achieve the required functionalities to build the application, is an ideal distributed software development paradigm for the complex simulation system.[4] In SOA, simulation components are loosely coupled. They can be discovered and composed to form a simulation application.[5] The components can be deployed to heterogeneous platform and communicate via standard protocol, such as XML, SOAP.

Distributed & Parallelized SMP2 Simulation Framework (DPSSF) takes the SMP2 as the model development standard and the SOA as the system development paradigm. DPSSF provides a solution for the Simulation Analysis and Evaluation of complex systems. This paper construct the Navigation System Volume Simulation based on the DPSSF.

2. Navigation System Volume Simulation

Navigation System Volume Simulation (SVS) provides the ability to analysis the navigation performance and integrity over large region and long time, it can be used to compare the constellation's designing schemes and analyze the navigation performance (precision, availability, continuity) of the constellation. During the operational phase of navigation system, it can be used to evaluate the effect of satellite failure, assist the constellation's extending design and analyze the navigation performance of the constellation integrated with other navigation systems. SVS system supports the analysis of Visibility, Coverage, Geometry, Dilution of Precision (DOP), Navigation System Precision (NSP), etc.

The receiver to satellite visibility is an important performance measure of navigation System's performance. The visible satellites decide the receiver's selection of satellites composition, which greatly affects the precision to Positioning, Velocity-measuring and Timing.

Coverage is a rationality measure of constellation. A reasonable constellation design should max the coverage of earth's surface contemporarily minimize the quantity of satellites.

Geometry analysis contains Receiver to Satellite's Doppler rate/ velocity, elevation, azimuth, etc. These criterions reflect the constellation design's influence on the performance of navigation system.

DOP is an import performance measure of the rationality and navigation capability of designed