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THE ARCHITECTURE OF COLLABORATIVE SIMULATION ENVIRONMENT FOR MECHANICAL PRODUCT BASED ON SRM

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ABSTRACT

The using of CAE (Computer Aided Engineering) software is a great challenge for most engineers, although their usability evolved dramatically recently. This is because the using of CAE software requires too much knowledge, which involves theories of multi-physics analysis, product and analysis modeling, large dataset management, simulation task management; report generating, data/progress auditing/reviewing and etc. To fill in the gap between application and CAE software, we introduce the concept of Simulation Requirement Model (SRM).

SRM is a generalized, abstract and CAE software independent model used to describe simulation object, simulation task, simulation executor and organization of simulation task flows. It is a unified logical model of basic simulation elements. The basic element includes: simulation object, simulation type, simulation task and sub-simulation task, assistant task, simulation flow, task executor and etc. SRM is the core of our software product, the Collaborative Simulation Environment (CSE). We divide the whole product simulation procedure into small fragments of reusable simulation tasks and abstract them into simulation components. The simulation components then can be collected and reused to assembly new simulation procedures. Each simulation component corresponds to a specified CAE or CAD software operation. As simulation tasks are executed simulation data will be collected into Engineering Management Database (EDM) automatically. The input/output file name and the related CAD/CAE operation are held by the simulation component as properties.

The SRM can be organized into three related views: simulation object-oriented view, simulation type-oriented view and simulation flow-oriented view. View is virtual relation of SRM data defined by combining data fields and/or properties. Simulation object-oriented view consists of a three level hierarchical tree of product, components and parts. In this view, simulation object is the main carrier which carries simulation object related simulation task and sub-simulation task. In simulation type-oriented view, simulation type is the main line which carries simulation object and object-related simulation tasks. Analogously, in simulation flow-oriented view, simulation flow is the backbone which carries flow related simulation object, simulation type, simulation pre- and post-condition, task executor and etc.

The SRM must be instantiated to certain CAE software before it can be executed due to its software independency. The instantiation of SRM involves unified interface, software agent and data driver. The unified interface, software agent and data driver provide identical software calling convention and data management.

Based on the concept of SRM, we establish software architecture to implement our idea of simulation data and flow management. This software architecture results in the Collaborative Simulation Environment (CSE). To construct a computing environment integrating multi-simulation software, we need database management technology, collaboration technology and workflow management technology, and we must integrate CAD design tools, CAE analysis tools, flow edit tools, user management and other self-coded computing programs.

In the CSE functional framework, database and model database is system level support layer which provides data and model exaction and storage management. On the basis of functional framework, we build five-layer CSE software architecture. The five layers are: tools layer, distribution layer, management layer, representation layer and user layer. Tools layer involves integration of all kinds of software tools, such as SolidWorks, ANSYS, MSC.NASTRAN, and Adams and so on. The distribution layer consists of Enterprise Service Bus and Grid Computing Platform. Distribution is used to support web service technology based software adaptor and software agent. The management layer includes user management, simulation flow management, simulation data management and message service. User management is used to manage authorities of users. Simulation flow management involves flow creation, flow execution, flow surveillance and flow reuse. Simulation data management manages the simulation data generated during simulation procedure, such as CAD model, CAE model, CAE post-process data, parameters, flow data and user data. Representation layer consist of web portal and CAE workbench. Web portal provides user with web browser based portal into CSE system. User can control simulation flow, view simulation results and generate simulation report through web portal. User layer offers the management of user identities, such as user name, password and role.

Standard programming technology is used to reply the complexities and varieties of enterprise environment. Java technology is used to insure operating system independency and database mid-ware is used to insure database system independency. Standard HTML and java script is used to insure internet browser independency. Web service based software agent and adaptor are developed to eliminate the dependency of CAE software. As a result, CSE can be used on mainstream operating systems, such as Windows, Linux, Solaris and AIX; and it supports mainstream browser, such as Internet Explorer and Mozilla Firefox. Opening is another consideration during the development to avoid turning CSE into another information islet. CSE uses XPDL, SOAP, WSDL, WSRF, WS-Notification, XMPP and LDAP to cooperate with third party software.

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