Research on Multi - Person Parallel Modeling Method Based on Integrated Model Persistent Storage

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Abstract. This paper mainly studies the multi-person parallel modeling method based on the integrated model persistence storage. The integrated model refers to a set of MDDT modeling graphics system, which can carry out multi-angle, multi-level and multi-stage description of aerospace general embedded software. Persistent storage refers to converting the data model in memory into a storage model and converting the storage model into a data model in memory, where the data model refers to the object model and the storage model is a binary stream. And multi-person parallel modeling refers to the need for multi-person collaboration, the role of separation, and even real-time remote synchronization modeling.

1.   Introduction

With the rapid development of computer information technology, due to the system design of small errors caused by huge losses can be seen everywhere. August 1998 the United States launched Delta Ⅲ rocket, shortly after the explosion, after the investigation concluded that the rocket control system software design is not correct; in 1999 because there is no check out the metric unit and the British unit does not meet, which led to the failure of the Mars meteorological satellite. Thus, in order to ensure the reliability of embedded software security, graphics modeling has been widely used in embedded software. However, the complexity of embedded software led to the model is too large, single modeling into a short-term work of modeling; multi-person parallel modeling method was put on the agenda.

In this paper our objective is to provide a multi-person parallel modeling method based on integrated model persistence storage, use data persistence storage method, enhance the reusability of program code, and divide complex modeling projects into A number of modules, so that modeling staff in accordance with the authority of the division of labor, speed up the modeling speed and improve work efficiency.

2.   Literature Survey

The integration model is based on the principle of "top-down, streamlining, main line and full testing"[1, 2]. "Top-down" principle refers to the modeling to reflect the "from coarse to fine, layer by layer" process. "Type streamlining" principle refers to the test graphics system to avoid redundant overlay graphics and the elements [3]. "stage main line" principle refers to the demand analysis, summary design and detailed design respectively DFD, PSD and PFD as the main line. "Test adequacy" principle refers to support different stages of testing and play the existing classic test

technology, such as black box testing in the equivalent class division and boundary value analysis and other methods [4].

3. Multi - Person Parallel Modeling

Based on the principle of "top-down, type streamlining, stage main line and test adequacy", the integrated model described in this paper consists of Data Flow Diagram (DFD), Program Structure Diagram (PSD), Program Flow Diagram (PFD), Activity Diagram (AD), State Transition Diagram (STD), Sequence Diagram (SD), Interaction Diagram (ID) , Fault Tree Analysis (FTA), Cause Diagram (CD), Decision Table (DT).

The integrated graphics model supports nested modeling between graphics (constructs subgraphs nested under the parent graph primitives), and the data graphs are top-level graphs. The nested relationships are shown in Table 1:

Table.1

Subgraph \ Parent graph	DFD	PSD	PFD	SD	ID	AD	STD	FTA	CD	DT
DFD	√	×	×	×	×	×	×	×	×	×
PSD	√	×	×	×	×	×	×	×	×	×
PFD	√	√	√	×	×	√	√	×	×	×
SD	√	×	×	×	×	×	×	×	×	×
ID	√	×	×	×	×	×	×	×	×	×
AD	√	√	×	×	×	√	×	×	×	×
STD	√	√	×	×	×	√	√	×	×	×
FTA	√	√	√	×	×	×	√	√	×	×
CD	√	√	√	×	×	√	√	×	×	×
DT	√	√	√	×	×	√	√	×	×	×

The steps of the multi-person concurrent modeling method based on the integrated model persistence storage are shown in Figure 1.
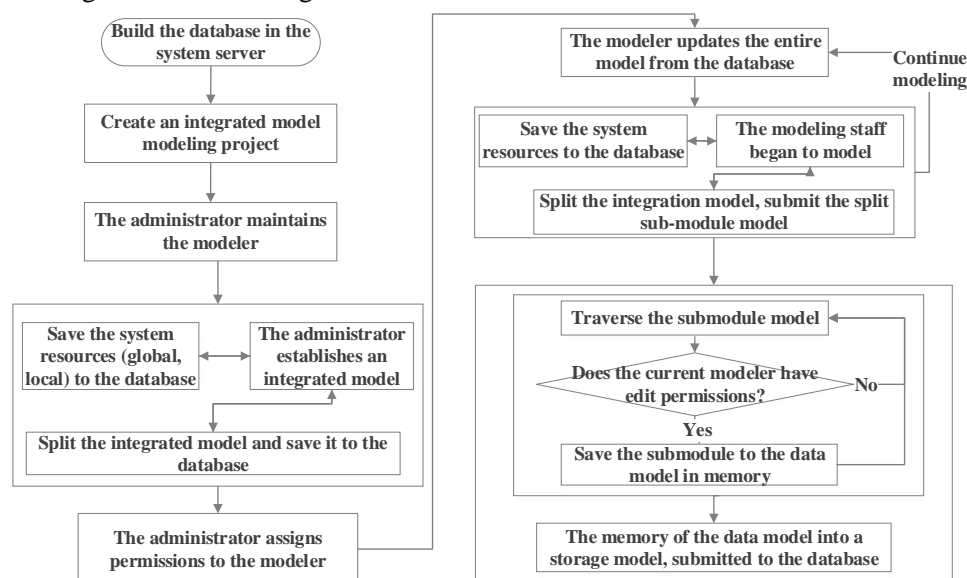

Fig.1 The steps of multi - person concurrent modeling

In this paper, the formal method is used to formalize the embedded software, and many people together model an integrated model. The concrete realization method is:

 (1) Formalize the embedded software by formal method, construct an integrated model composed of data flow diagram, fault tree, causal map, state diagram, timing diagram and judgment table, and then analyze the model. Model split criteria to split the model to save;

(2) The use of database tables to achieve the synchronization of model system resources to save;

(3) The administrator assigns permissions to the modeler using the permission assignment criteria.

(4) The use of database tables to achieve the authority of the model resources control and synchronization.

(5) The use of object model and binary flow, the model data to achieve data persistence.

The model split criteria are as follows:

(1) According to the graphical nesting rule of the integrated model, the integrated model is divided into subgraphs of different graphs;

(2) extract the software behavior and software structure information of each subgraph;

(3) Each subgraph is stored in the form of binary streams to the database;

(4) Save the record contains the current modeler, graphic number, the parent module model number and sub-model of the binary stream and so on.

The criteria for the assignment of rights are as follows:

(1) The administrator has the right to modify and delete the entire project;

(2) The administrator can assign permissions to all the builders for the Subgraph.

(3) The modeler has read and write access to the assigned subgraph, and has read-only access to the subgraphs assigned by other modelers;

The integration model divides the different sub-modules according to the graphical nesting rules. All the sub-modules are obtained according to the integrated model. Then, the number of each graph, the parent module's graphic number, nested structure and graphics Information is saved. Among them, the graphical nested sub-model refers to the overall model of each graphics model; the graphics number will be dynamically given. The specific algorithm description is shown in Algorithm 1.

Algorithm name: Algorithm 1

Enter: complete integration model   Output: Sub-module binary stream

Process:

(1) To obtain a complete integration model; (2) From the top of the data flow chart to start graphics analysis; (3) traverse all sub-module models according to the graphical nesting rules; (4) Get the sub-module model information, automatically generate the graphics number and obtain the parent module graphics number; (5) The sub-module information into a binary stream to the physical storage layer.

The integrated model does not save the graphics information, only for the database storage model of the graphical display, easy to intuitively test and debugging. The database used by the persistent storage is built on the LANs created by all the modelers, and all the builders are connected to it. Modeling staff from the database real-time maintenance and read system resources to ensure the consistency of resources to achieve synchronization of system resources. The modeler synchronizes the project to the local through the "check-in to the local", and maintains the model information according to the authority to achieve multiplayer parallel modeling.

4.   Experimental Results

To implement a multi-person parallel modeling method based on integrated model persistence storage, the model and permissions related tables are as follows:

(1) USER_INFO for the user table, used to store the graphics model of the account, as shown in Table 2.

Table.2 USER_INFO

Column Name	Data Type	Remarks
USERID	int	User ID, primary key
USERNAME	varchar(64)	username
PASSWORD	varchar(64)	password
USERTYPE	char(1)	User type (administrator, normal user)
MODIFY_DATE	datetime	Modify date

(2) OBJECT_TABLE model object table, used to store the model top module and its sub-modules, as shown in Table 3.

Table.3 OBJECT_TABLE

Column Name	Data Type	Remarks
ID	int	Primary key
FOLDERNAME	varchar(64)	Modeling user name
PARENTID	varchar(MAX)	Parent model object number
OBJECTID	varchar(64)	Graphic object number
OBJECTNAME	varchar(MAX)	Graphic name
OBJECTTYPE	varchar(64)	Graphic type (data flow diagram, program flow chart, program structure diagram, fault tree, state diagram, sequence diagram, activity diagram, cause and effect diagram, interaction diagram)
CONTENT	varbinary(MAX)	Graphic content
PROJECT_NAME	varchar(MAX)	project name
MODIFY_DATE	datetime	Modify date

(3) OBJECT_GRANT user rights table, used to store the model can edit the module, as shown in Table 4.

Table.4 OBJECT_GRANT

Column Name	Data Type	Remarks
USERID	int	User ID
OBJECTID	varchar(64)	Graphic object number
PROJECT_NAME	varchar(MAX)	project name
MODIFY_DATE	datetime	Modify date

Experiments show that the proposed multi-person parallel modeling method based on the integrated model persistence storage is correct and feasible.

5.   Conclusion

In this paper, an embedded software multiuser parallel modeling method based on integrated model persistence storage is proposed. After deep understanding of the software under test, a structured analysis method is used, which uses data flow diagram, fault tree, causal map, state diagram, Time chart, decision table and so on, and the graphical model of the nesting mechanism between graphs to describe the embedded software, and then analyze the graphics model, the use of persistent storage, permissions control method to achieve multiplayer parallel modeling.

The method proposed in this paper has the following advantages:(1) Integrated model can respond to embedded software in a timely manner changes in demand, better maintenance;(2) Using data persistence method, the program code is highly reusable; (3) the complex modeling project is divided into several modules, so that modeling staff in accordance with the authority of the division of labor, compared to traditional modeling methods to greatly speed up the graphics modeling speed;(4) To identify the modeling staff of the modeling tasks to facilitate the management of unified management.

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