

Research on Simulation Scenario Entity Transform Based on Visually Mapping

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Abstract. Simulation scenario is the data base of simulation system. The current simulation scenario can often be applied to single simulation system. There are problems like the low reusability of old simulation scenario, long time when the large number of entities are created and so on. This paper studies the mapping relationship of simulation objects between different specifications, visually saving this mapping relationship to the data dictionary, and through the simulation object instantiation and data query to transform old entities to new entities that simulation system is able to identify. In MAXSIM Simulation System Development, this way greatly reduce the simulation scenario development time and ensures the accuracy of the data.

Keywords: Simulation scenario · Visually mapping · Entity transform

1 Introduction

Simulation scenario is the digital base of simulation system which makes system run smoothly. It's also the key part of the simulation system. The present simulation scenario is firstly set by the military technical personnel after they make a good military scenario, and then technology personnel according to certain standards, cost a lot of time to convert it into data simulation scenario data. However, due to the various groups of the simulation scenario description, development methodologies and final data format is not exactly the same understanding, making big difference between simulation scenarios.

To achieve the simulation system you want to reuse the given data and avoid developing simulation scenario authoring software when simulation rules transform, we need to do the research on the simulation scenario conversion technology and by this simulation scenarios of different standardized descriptions can be quickly transformed. Simulation entity as the key part of simulation scenario is the core of this paper. This paper will focus on different simulation scenario type set of entities, attributes, and the same simulation entity mapping relation dictionary under different description specifications, and then by querying the mapping dictionary, the old simulation entities will be converted as new simulation entities that can be identified by simulation system.

The rest of this paper is organized as follows. Section 2 describes the related work. Section 3 introduces how to get the correspondence between the entity classes and their

attributes and save as dictionary. Section 4 uses the mapping dictionary to quickly generating simulation entities. Section 5 concludes the whole work of this paper.

2 Related Work

Recently, there is a lot of research on the simulation scenario conversion. Chao-yang Liu et al. come up with the conversion technology based on MDA. This technology can well realize the transformation of independent model in different scenarios, but for the “heterogeneous” problem with different description specification (Due to the description of the simulation scenario, development methods and the understanding of the final data format are from different groups, it makes database are different from each simulation member’s database and storage modes) it is not a very good solution. The transformation of heterogeneous object classes is unrealizable. Meiyang Zheng etc. want to set the data conversion interface based on HLA, it implements from military scenario to simulation scenario, together with the method of mapping, convert military conceptual entity to simulation data entity. It has a good reference for how to transfer different simulation entities under different description specification. Wenzhen Li etc. present an air force scenario description based on the Agent, used to generate scenario quickly. But this scenario generation was more by simulation personnel through contrast military scenario in manual configuration software, cannot realize quickly generate of scenario entity.

The present scenario transformation research mainly exist the following problems:

- (a) Can’t solve the “heterogeneous” problem due to different description specification and different entities in different simulation scenario.
- (b) In the process of simulation scenario transformation, object instantiation can only be made by time-consuming manual configuration.

This paper takes MAXSIM simulation system as the background, study on the simulation object visualization mapping technology under different description specification, form a mapping dictionary which can store the same simulation object under different specification mapping relation. By querying the mapping dictionary, converts the old simulation scenario entity to new simulation entities that system can identify, to realize the transformation of the simulation scenario entity.

3 The Simulation Object Visually Mapping

“The simulation object visually mapping” is to achieve visually configuration simulation object classes and their attributes and to form the corresponding “dictionary”. To provide a data basis for simulation scenario conversion, this chapter will introduce simulation object visually mapping technology from three aspects:the implementation principle, implementation method and software implementation. Its work mode is shown in Fig. 1.

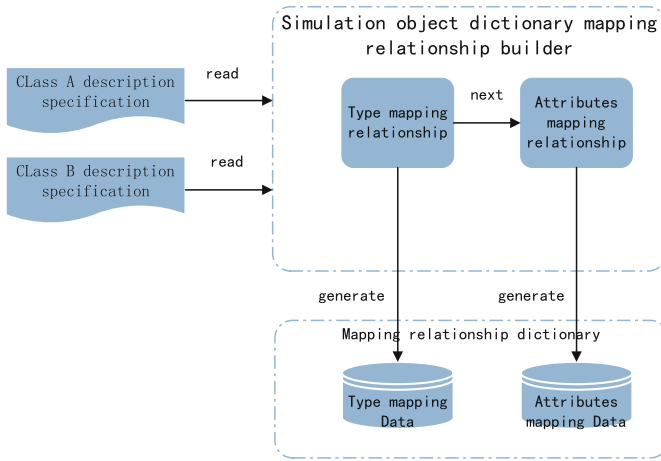


Fig. 1. The simulation object visually mapping

3.1 The Principle of Implementation

Under the description of the different specification, the same simulation objects such as aircraft may have different names, like “aircraft”, “plane”, “airplane” etc. The structure may be different as shown in Fig. 2. Two different scenario describe plane using XML data format specification.

<pre> <PlatformList> <Platform TKBID="01" TypeName=" aircraft-1 "> <SensorList> <Sensor Num="1", TKBID="0102",Name="SPS-10" /> <Sensor Num="2", TKBID="0112",Name="SIR" /> </SensorList> </Platform> </PlatformList> </pre>	<pre> <PlatformList> <Platform SID="71" Name=" plane-1 "> <equipList> <SenseList> <Sense Num="1", SID="012",Name="SPS-10" /> <Sense Num="2", SID="112",Name="SIR" /> </SenseList> </equipList> </Platform> </PlatformList> </pre>
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Fig. 2. The same plane at different specifications

You can see that all are an instance of the plane but their names are different and attributes of organizational relationships are also different. The left side call it “aircraft”, and the right side is “plane”. The sensor suite of left side is directly mount on Sensor List, the right side is mounting on Sense List in equip List. This different specification makes left side of the aircraft cannot be used directly by the right side of the simulation scenario. But we can see that they have the same physical meaning—“airplane”, mounting on the same sensor—SPS-10 SIR and if they have other properties, they are also the same.

What we need to do is to save the “same physical meaning” and form a data document. When the computer reads the document, it will know “aircraft = plane”. When the computer reads Sensor List, knows is “my sense list”.

3.2 Implementation Method

Figure 2 as an example, realize visualization of simulation object mapping must solve the following problems:

- (a) How to make the computer know the aircraft and the plane are equivalent.

Technicians know both are the same when they see name, but the computer doesn't know, so you need to “tell” computer “aircraft = plane”. Because of storage and query difficulty, name as the matching characters is not available. We can see, no matter use which description, if you want the simulation scenario data can be read by the simulation system, each kind of simulation object has a unique identification code, so what we have to do is to get the identification code as a symbol of the query matches.
- (b) How to make the computer know corresponding relations between properties of aircraft and plane.

Such as “speed” in aircraft may be defined as “cruising speed” in plane, we need to do is to find the corresponding relations. Due to the different description in the specification, the attributes of simulation object maybe is different under the XML data structure. Some may be as a class of child nodes, others may be the properties of the nodes. In order to improve the speed of the query, we read its name as a match. Although there will be repeated in the data (“Speed”, “weight” and other general properties), but querying speed will get a lot of ascension.
- (c) How to save this mapping relationship, to form a data document that can be identified by the computer.

Use tree data structure to store the mapping relationship. The mapping relationship of object classes as the parent node, the corresponding relation of attributes as child node. When the simulation entity generator query “dictionary”, by iterating through the parent node to find the simulation object, and instantiation, find the corresponding relation of attributes from child nodes quickly.

The specific work process is shown in Fig. 3:

3.3 The Simulation Object Mapping Dictionary Builder

According to the above design, this paper designs generator software of simulation object mapping dictionary. It contains the following functions:

- Read two kinds of description specification: class A and class B. And displayed in the form of tree.
- Can easily match the simulation object types, properties under two description specifications, and generate the corresponding matching data.

It's working interface as shown in Fig. 4.

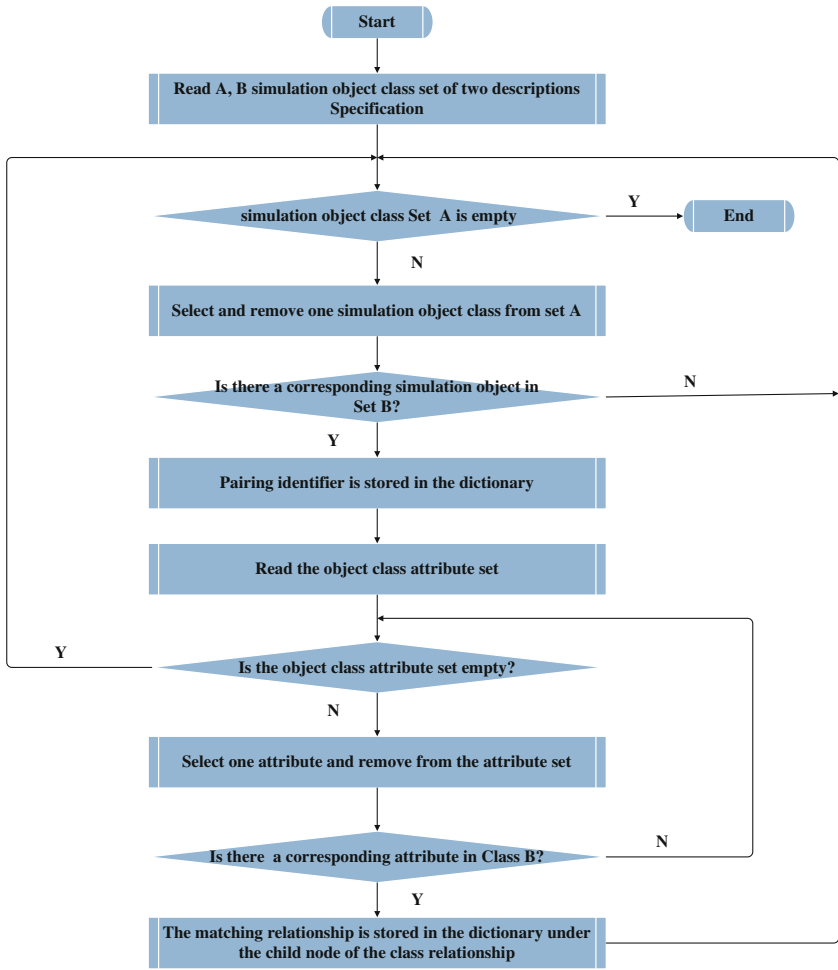


Fig. 3. Simulation object visually mapping technology processes

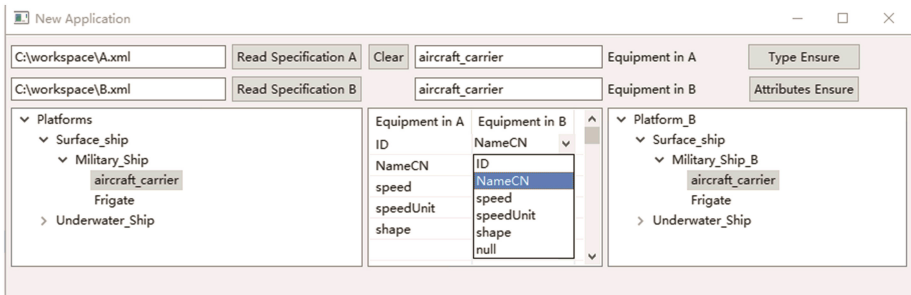


Fig. 4. Simulation object class mapping dictionary builder interface

Firstly, it will read the two specifications A and B. In the right and left sides, entity classes are displayed as tree structure. Secondly, double-click the entity class on the left side and then double-click the corresponding entity class on the right. Click the “Type Endure” button. It indicates that these two classes is the same entity. After that, attributes of these two entity classes will be shown in the middle. And then, select the corresponding properties in the drop-down menu B. If the attribute you do not need, you can select “null”. In the end, click the “Attributes Endure” button.

4 The Simulation Scenario Entity Conversion

The simulation scenario entity conversion is by querying the mapping dictionary, instance initialization, achieving quickly convert the old simulation entities to new simulation entities.

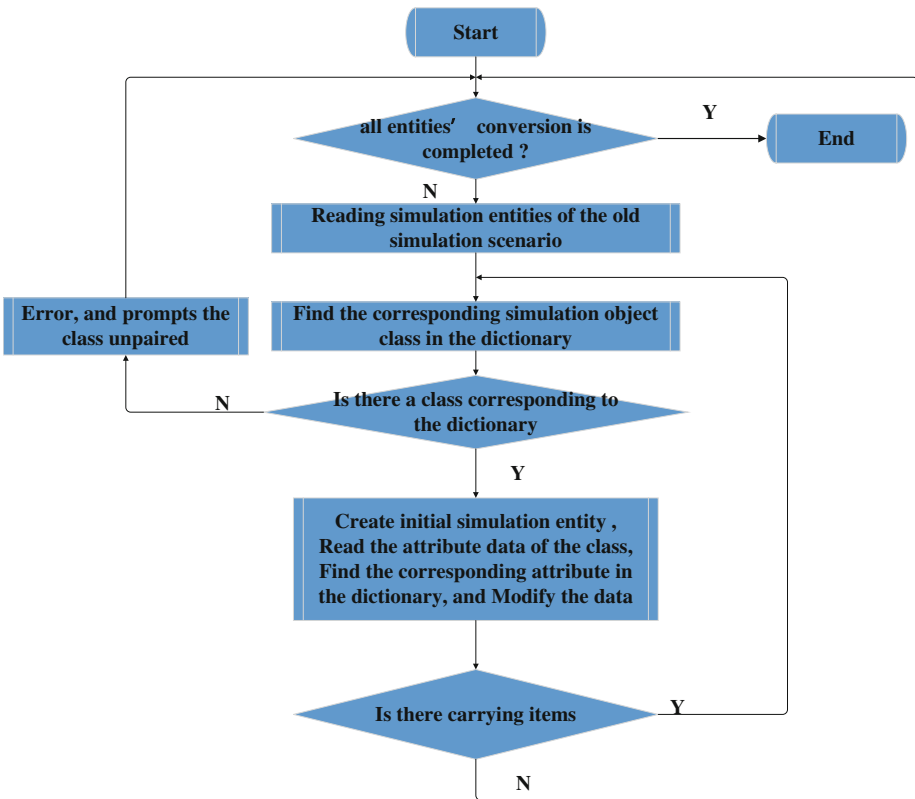


Fig. 5. Create entity process

4.1 Implementation Method

Entities in the simulation scenario mainly consist by types, properties, carrying relationship, etc. To transform all entities in the simulation scenario, we need to do the following works:

- All entities can find the corresponding simulation object instantiation.
- All entities after conversion are not lack of attributes. (Can run in a new simulation system).

Format stored “simulation object mapping dictionary” can satisfy the demand for the first item, when you read the class A primitive entities in the simulation scenario data types, querying the dictionary to find the corresponding class B simulation objects and then instantiate it.

Because of the different description specification, there may be some properties exist in new scenario but not in the old scenario, so meaningful initial values are needed to meet the needs of the new scenario. When the first creation is instantiation, by coping built initial instance, then read the corresponding attributes to modify it.

Its working process is shown in Fig. 5.

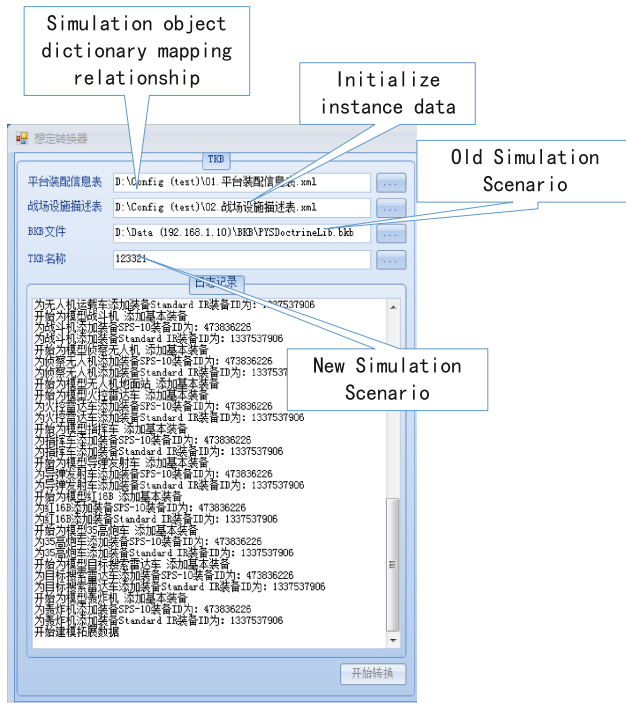


Fig. 6. Quickly generating simulation entities builder

4.2 Software Implementation

According to the above design, this paper designed simulation scenario entity conversion based on different description. Figure 6 shows the scenario entity conversion interface.

By reading the simulation object mapping dictionary, initialize the instance data of new simulation object, the old data simulation scenario, etc. Enter new name of the entity, click start conversion.

4.3 Validation

The process of making scenario data in MAXSIM simulation system, 17 kinds of 367 entities, costs 22 min to finish transformation. Visually mapping relationship of entity and attributes costs about 16 min. Generating entities only cost 3 min, and other 3 min are for operating software, inputting names of files and other things. The proportion of each part is shown in Fig. 7.

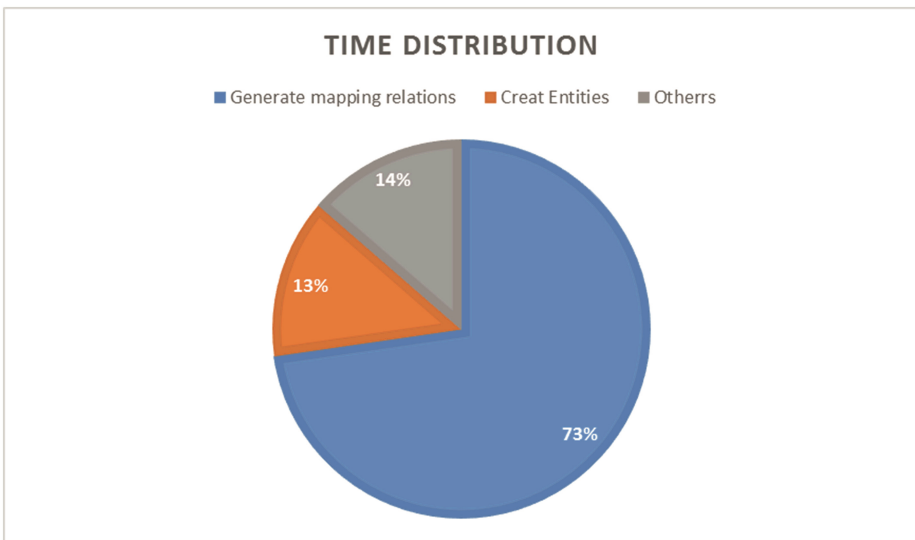


Fig. 7. Time distribution

5 Conclusion

Through the research of simulation scenarios conversion technology based on different description specification, we can make the original scenario entity quickly generated under new description specification and ensure the correctness of the data, enables the simulation technology personnel to focus on the development of simulation system, regardless of the specific military technologies.

This technology has been practiced in MAXSIM simulation system. In making a new simulation scenario, fully use the existing simulation scenarios, save much time of making scenario, improving the progress of research and development.

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