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Research and Implementation of Visualization of Combat Data

YanYu¹, XichunChen¹, JingliZhang¹, ChenZhao¹ and XichunChen*¹
¹Mechanized Infantry Department, The Army Infantry Academy of PLA, Shijiazhuang, HeBei,050083, China
*Corresponding author’s e-mail:yuyan_hbu@sohu.com

Abstract. With the development of information technology and sensor technology, we can get and use lots of multi-sensors data more frequently, which acquired from military action. It has become difficult for users to find information that satisfies their needs, so it has become a great challenge for information science and technology that how to organize and process the massive documents quickly, exactly, and fully. This paper propose a method of combat data management using ArcSDE spatial data engine with ESRI and relation database, based on analyzing all kinds of method of combat data management. The authors developed combat data analysis system based on ArcEngine, implementing data visualization, put data into SDE database and Dynamic display. The paper explains some interfaces in AE briefly, and the system has achieved the anticipated effect under the test.

1. Introduction
Entering the twenty-first Century, rapid and drastic changes are taking place in the military field around the world, strengthening the training way based on the base being gaining universal popularity among countries in military training. The future war will "be launched" in battle labs first. For the performance of the army, it means that they will encounter all kinds of situations that may be encountered in future battlefields, many of which are not encountered in the training field. Furthermore, the combat capability and adaptability of officers and men will also be tested, under the contest of both sides.

Therefore, operation experiment is a result which examines and reflects the Military capability about military decision and action. Nowadays, military personnel could collect and do real-time record through a series of effective measures and policy, with development of science and technology. Reasonable and effective use of these data can provide decision-making and support for military theory. The presentation of operational data is the basis for data analysis. through the second-hand ArcEngine developments. According to the time sequence of the hitting event, visualize the operational data then replay in chronological order. Then the information of time, position and event-related attributes should be shown on the map directly, which could offer sustenance to future work.

2. Temporal Data
Traditional GIS (Geographic Information System) is static when describing the Research object, it is only the response of the object's current state, but it almost impossible reflect its past status or predict its development trend. Therefore, increasing the capability of expression and analysis with time dimension, is extremely essential, using that to analyze the historical case and forecast the future development trend can come true.
So, the data of temporal GIS, which should have been present in the form of geographic information, could dynamically display the information in the event. By that measure, the position of moving Army change constantly over time should be described, in order to analyze mobility, and it make the consumption such as oil, ammunition, intuitive and easy-to-read to the users, in the field of operational experiments. There are some key terms you should know when managing and visualizing temporal data. These are identified below.[1]

| Term                          | Interpretation                                                                                                                                 |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Time-enabled layer            | A layer that will display data based on the current time of the time slider. A layer can be time enabled by setting the time properties on the Time tab of the Layer Properties dialog box. |
| Time instant                  | Refers to a single point on the timeline.                                                                                                     |
| Time stamp                    | The time attached to a piece of data (feature, image, and so on). The term stems from the idea of stamping a document with the time it was received. The same general concept holds true for data. The time stamp could be a single instant or a time interval. |
| Time step interval of the time-enabled layer | Identifies how frequently the data was collected or updated. The time step interval of a time-enabled layer is used by the time slider. |
| Time step interval of the time slider | The duration after which the map, globe, or scene will be refreshed to display the data valid at that time. |
| Time extent                   | The period of time between two points on a timeline.                                                                                           |
| Time extent of temporal data  | The period in time within which the data was collected. Basically, it is the distance between the minimum and maximum time stamps in your time-enabled layer. |

Before importing properties into the Analysis System, the time value itself should be contained in the properties, and the types of fields can be text, numeric, and date. It is necessary to pay attention to standardizing the basic data before importing, eliminating illegal data and characters.

Important: To accomplish this task, should note the following points.
- Storing temporal data by row structure
- Storing time values with date fields
- Time value as index
- Using standard time

All required data that for the purposes of this program is imported from Excel Table. The table field which is "dTime" as corresponding time attribute of event and the format cells as "time" are completely necessary. The screenshots is as shown in the below picture.
3. Design and Realization

3.1 About ArcEngine

The ArcEngine is an ArcGIS software engine, which is used to develop. ArcEngine provides application programming interfaces (APIs) for multiple platforms, which include a series of high-level visual components to ease building the custom GIS desktop applications[1]. ArcEngine provides the corresponding component class library for the different functions, which mainly contains the following five parts.

| Note | Component Library |
|------|-------------------|
| Basic services | Composed of GIS core ArcObjects, almost all GIS applications, such as geometry and display, are required. |
| SystemUI | Geometry, Display, Server, Output |
| Data access | Access to raster and vector data, including GeoDatabase. |
| GISClient | GeoDatabase, DataSourcesOleDb, DataSourcesFile, DataSourcesGDB, DataSourcesRaster, GeoDatabaseDistributed |
| Map expressive | Create and display ArcObjects objects with symbols, Carto annotated maps, and thematic maps. |
| CartoComponent | Advanced user interface control and integrated help system for rapid application development. |
| ArcReader Control | LocationNetworkAnalysis, GeoAnalyst, 3DAnalyst |

Figure 1. Operations as the graphic.
Table 2. Component Library.

| Note | Component Library |
|------|-------------------|
|      | GlobeCore         |
|      | SpatialAnalyst    |

The technical points for functional implementation is setting and calling the data layers of temporal, for this article. Reserved interface by ArcEngine based on the need to develop the playback facility of event information by time, according to the actual requirements.

There are several primary interfaces as follow[2].

Table 3. Primary Interface

| Interface                  | Class Library |
|---------------------------|---------------|
| ITime                     | esriSystem    |
| ITimeExtent               |               |
| ITimeReference            |               |
| ITimeZoneFactory          |               |
| ITimeDisplay              | Display       |
| IData                     | Carto         |
| ITimeTableDefinition      |               |

3.2 An instance

To realize the function of visualization of combat data, the essential process is to import the related data and generate the temporal data layer, then at last programming the function, based on ArcEngine. This sample shows how to configure the TimeSlider to filter combat data by date. The TimeSlider is configured to have two thumbs so only data occurring between the two thumb locations is displayed. The setThumbIndexes method determines the initial location of each thumb[3]. In this case a thumb is added at the initial start time and another thumb is positioned one time step up. The thesis concerning research work should take place in two instalments.

- The first step: Creating a map document.
  - create the battle area map
  - import data from external application
  - bring the imported data as a layer of map document
- The second step: programming.
  - load the map
  - set the properties of the temporal data layer
  - dynamically displays all data

Therefore, the solution, based on ArcEngine, using C# scripting language, for how to visualize the data, which record great deal of information about firing and hitting, in the combat experimentation. The combat data could be shown on the map in the time order that the hitting event take place, by the data display function sub-module, which belongs to Analysis System of Combat Data.

4. Summary

Aiming at the visualization problem of damage data in operational experiments, this paper introduces the concept of temporal data and related terminology and ArcEngine interface. Using the C# script language, based on the ArcEngine, the dynamic presentation of the damaged data in the combat area is realized, and the exercise process is displayed more intuitively in front of the commander, which provides powerful technical support for the follow-up analysis.
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