

Integrating AIDS-Agent Model and GIS

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Abstract. GIS is difficult to handle dynamic spatial information, especially spatial information with temporal and spatial characteristics. The agent can describe and deal with the intelligence, random geographical phenomenon, and the individual agent model can simulate the process of change over time. Integrating GIS and agent model can solve the GIS analysis of the phenomenon of dynamic geographic processing capabilities. The paper focuses on research the method of integration. Firstly, sorting out the current mainstream integration approaches of Agent model and GIS. Then, using a component-based embedded integrated way for the agent's own characteristics and is now the mainstream of development approach. Finally, an example of the integration experiment is tested based on AIDS spread.

Keywords: Integrate, AIDS-Agent model, GIS

1. Introduction

Integration is new concept which generated from the modern electronic technology and the development of computer. So far, Integration in the concept has not been approved unanimously. The prevailing view is that integration is organic combination of different elements which are from different sources, not a simple interconnection of Inter-Connection. Integration was first used in the field of circuits, but by now, integration has been applied to many fields.

Integration between GIS(Geographic Information System) and Model began to be concerned by people in the late 80. The earliest researcher who research GIS integrate spatial analyst model is Goodchild. Since then many scholars do some research between the two paradigms and approaches based on integration of different levels and sides. University of London Research Centre for Advanced Spatial Analysis and GIS model used agent technology to simulate the flow of emergency evacuation of the London Underground Status. Manchester Metropolitan University used GIS and agent technology to find the socio-economic status on HIV / AIDS and its relationship. Brown,D.G. researched spatial analysis and data model by GIS and agent technology. North,N. developed Agent Analyst software that achieve to integrate between GIS and agent based modeling. Gong Jianhua model the spread of SARS by virtual geographic environments platform [1].

2. Integration Method

Agent models and GIS integration method depends on the application and integration of goals and complexity of the underlying data and GIS functional requirements, interface usability and compatibility of data models, hardware environment, GIS and modeling software system architecture Etc [2]. According to the different degree of integration, integration methods are divided into loosely model, closely model, GIS embedding models and model embedding GIS, 4 categories [3].

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- Loose model. Model system and geographic information systems in parallel with each other, independent, each has an independent data structure and user interface. Their data communicated with each other by the middle of text files and other files, reading and writing standards. They each have their own systems and data management capabilities, and not combined into a unified system.
- Close model. Developing multi-agent simulation model of AIDS based on GIS platform by embedded Development Language, Such as Mapbasic, Avenue, AML macro language or scripting language.
- Embedding model into GIS. This approach is based on GIS as the core, embedded in its internal model of the corresponding spatial analysis. Due to the design of the underlying GIS data structure, usually the GIS experts and model developers complete it.
- Embedding GIS into model. This approach is based on simulation model as the core, the use of DLL, OCX to ActiveX technology, with high-level programming languages such as CC / + +, Pascal, Fortran, Basic, etc. In the model system, based on the development of geographic information system functions necessary to support intelligent agent behavior space.

Four ways has each of advantages and disadvantages, in different circumstances, the choice of the integration of different ways.

Table. 1: Integration method comparison

Integrated Approach	Advantages	Disadvantages
Loose model	Model and GIS are not bound by the other, they have their own data structures, analysis and user interface.	Redundant data between systems, the conversion efficiency is low, error-prone; Lack of a unified interface, poor systemic; Difficult to achieve visualization of the dynamic simulation.
Close model	Powerful GIS	The ability of develop language is poor. Difficult to develop autonomy, learning ability agent simulation model.
Embedding model into GIS	This way can take full advantage of GIS analysis functions. The effectiveness and efficiency of model operation can be guaranteed.	GIS developer cann't do it alone, it requires the participation of experts of model. This approach increase of the difficulty of integration.
Embedding GIS into model	In this way the model designer has great freedom to design and adjust the model, especially for high-level analysis of some recent developments in the exploration model is very favorable.	In this way the workload is very large, data management, model and results of operations are required to visualize overall consideration by the modeler, the model structure are demanding.

Agent model as a dynamic model, you need to manipulate data in real time, it is clear a loose integration approach is difficult to meet this requirement; Close integrated approach requires use of the GIS platform developed with the host language of intelligence, learning ability agent model, however, provided by the host language itself limited functionality, is difficult to build agent models to achieve the functionality required. Therefore, for GIS integration with the agent model, the loose and close integrated approach is very difficult to achieve real integration [4]. GIS embed model and model embed GIS both in nature and are based on fact, components of GIS technology will be integrated with the agent model into a unified platform, and to achieve a common operation for data processing.

3. Integration Framework

Regardless of which way to integrate the core of the GIS and the agent is an organic combination of model, to play to their strengths, compensate for their deficiencies. AIDS and HIV carriers all the life, work and other activities take place in geographical space, while changes in the geographical space activities will also affect the regularity of people with AIDS, there is interaction between the relationship of mutual influence [5].

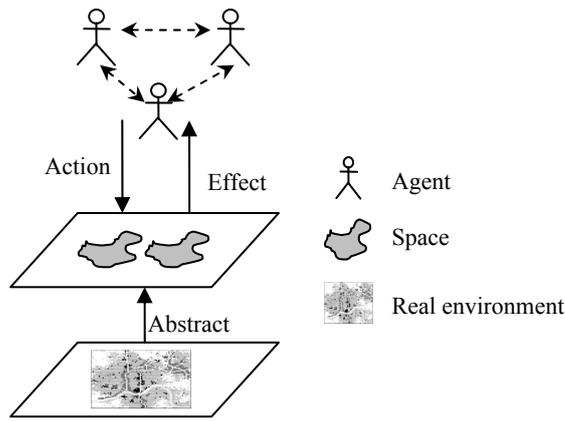


Fig. 1: AIDS agent model and GIS spatial data model interaction

Fig1 is a simple conceptual model picture, the picture shows the AIDS agent and the real geo-spatial environment interaction. AIDS agent model is a dynamic micro-model that focuses on simulating the individual behavior. Individuals in space can be abstracted as a point of coordinates and attribute information. So, AIDS can be made for the point layer by GIS platform software. We can be achieved seamless integration with GIS based on the point layer to build agent-based model of agent model [6]. This method does not result in asynchronous communication problems. Because the role of agent models and GIS objects are the same thing. Figure 2 shows the integration of the technical details.

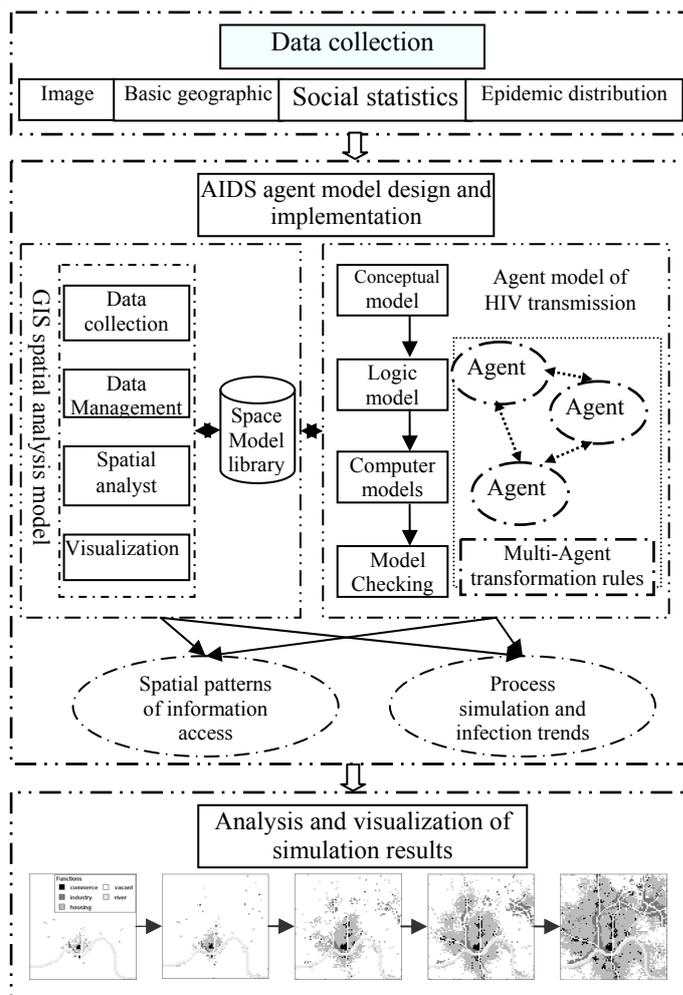


Fig. 2: The framework of AIDS agent model and GIS Integration

In the integrated framework, GIS and AIDS-agent models share the same spatial data, and support each other in function. Agent model of AIDS access the spatial distribution, spatial pattern and other information

through integrated. GIS get transmission trend of the dynamic process of change and other information through the integration. Therefore, the integration of both in a real representation of the epidemic spread of geographical space and spatial trends of changes in the pattern, for the prevention and treatment of AIDS epidemic has provided a basis for decision support.

4. Integrated Case

In this case, select the ArcGIS Engine development tools as GIS functions, while using Repast as agent modeling tool. Case data selects Kunming city-wide basis vector data and building AIDS-agent model information and data related topics. GIS functions developed using Microsoft's Visual Basic6.0, agent modeling almost all of the modeling tools are Java-based development, so the agent model used Eclipse3.4.2 [7].

In this case, integration of GIS and agent models related to Microsoft's Component Object Model (COM) and SUN's Java component technology, because they belong to different technology systems, so a technology needed to achieve interoperability. In recent years, there have been several tools that enable Java components and lightweight integration between COM components. However, some of these tools can be applied is very limited, for example, they only support from the Java components to COM bridge (from the Java code calls a COM server method). The general design of the bridge for the instrument because of intensive interaction will result in a high performance overhead. IBM provides a good tool to solve this problems, this tool is Rational Java-COM Bridge (RJCB) [8]. RJCB support the bridge Java components to COM and COM to Java, but also provides a reasonable performance when component interaction through the bridge. RJCB technology uses the Java Native Interface (JNI) framework to bridge between Java code and COM bridges. The tools used to establish RJCB Bridge (Java-COM Bridge development tool, DTJCB) and the open source Eclipse IDE integration, making the establishment of a single Java environment and become very easy to use RJCB Bridge. You can use DTJCB build the bridge, using Microsoft's tools to build Java components from COM to the bridge. When you access COM from Java client server, you can continue to work in Eclipse. You can also add a bridge project with the interaction of the Java client proxy codes, it will run through the bridge for dialogue with the COM server library. In Eclipse DTJCB, provides an end-experience (the establishment of the bridge from the bridge to the actual call). When you access the Java client from a COM server, you must first register the Microsoft Windows environment, Java server, so it can be "exposed" to the COM environment. You can then use COM-based development tools (such as Microsoft Visual Studio, Visual C ++ or Visual Basic) write Java server via the bridge to access the client code.

In this case, the GIS platform as a principal, agent model of AIDS integrated into the GIS platform. GIS platform is based on ArcGIS Engine components developed to follow the second COM component technology development, and AIDS-agent model is developed using Java, to integrate the two using the Java-COM Bridge development tool (DTJCB) implementation. AIDS agent model will generate a dynamic link library (DLL) through the use of DTJCB, the GIS development platform using VB load the DLL, you can call the AIDS agent model, to achieve both in functional integration. To achieve full integration between the two there is a problem, that is data synchronization. As used Repast modeling tools have provided a loading Shape file format class `anl.repast.gis.data.GeotoolsData`. GIS platform loaded AIDS agent model data required to Shape format, when the model using ArcGIS Engine Runtime provides the refresh (Refresh) function continually refresh the map, you can achieve the results of model simulation results of synchronization with the GIS display, and ultimately the GIS and agent model of seamless integration. Figure 3 is the results of integrating AIDS agent model and GIS.

The above content focuses on the use of agent model written in Java and COM-based platform for integration of GIS technology development case. Although this integrated approach to achieve the agent model is tightly integrated with GIS, however, due to the use of two different technical systems (Microsoft's COM technology and Jun's Java technology), making the damage to its robustness, and in the operating environment becomes more complex structures. More rigorous and robust integrated approach should be used to complete the integration of a technology, or developed using Java, or COM technology developed. Agent model is currently in development using Java to achieve relatively mature, the use of COM technology development is still limited. In GIS development, the use of COM and Java technology

development are more mature. Therefore, based on the use of Java to achieve this situation agent model and GIS development is an ideal choice.

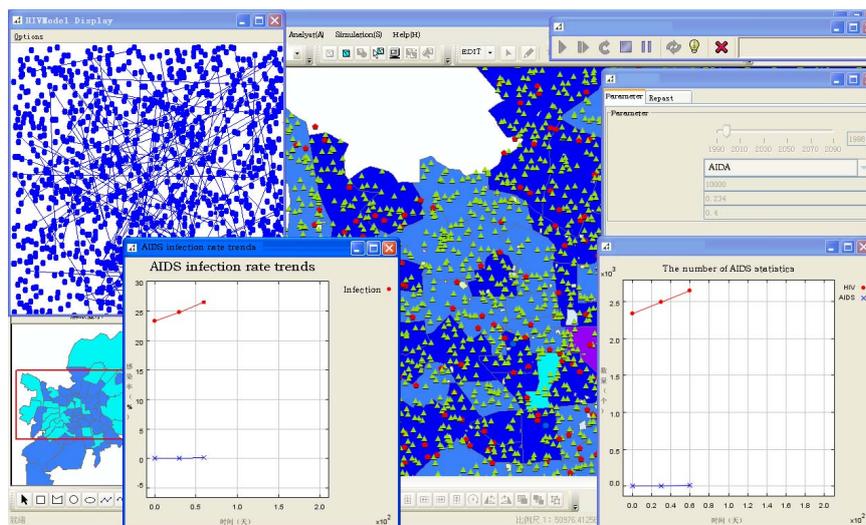


Fig. 3: The results of Integrating HIV agent model and GIS

5. Conclusion

ABM model and GIS Integration, the agent model of micro-dynamic simulation model of the traditional GIS features and static characteristics of a good macro together to form a true sense of the space-time dynamic simulation models. Like AIDS will help to solve a class of complex system of social problems, real-time monitoring and dynamic simulation of the overall transmission and spread of AIDS trends will make the public health sector to respond more effectively to major public health emergency events.

6. Acknowledgements

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7. References

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