Agent-Based Simulation of Rural Areas and Agriculture Information of 11 Country Units in Shandong Province

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Abstract. This paper constructed the agent-based modeling framework and discussed the mechanism and implementation of agent-based rural areas and agriculture information by open-source program on country scale. In the paper, 13 indices were proposed to measure the rural areas and agriculture information level in the overlay 11 country regions located in Yellow River Delta and the Blue Economic Zone of Peninsula. The energy node agents represented for informatization involved in agent context were also constructed, network and grid of rural areas and agriculture information. In the study, 11 informatization node agents were given as the energy for the comprehensive evaluation of rural areas and agriculture information, which indicated the strength changes of rural areas and agriculture information. Correspondingly, the node process simulation of rural areas and agriculture information was explored from dual strategy mechanism driving. Then the agent energy transmission mode was put forward for 11 informatization node agent, after that three grades change status of energy transmission was displayed in the study, which responded to the gradient changes of rural areas and agriculture information. Moreover, the spatial process of 11 informatization nodes was obviously described by the agent simulation with the Repast-S IDE, and the unsealed link among node agents was also analyzed in the paper.

Keywords: Rural areas and agriculture information；Agent-based modeling and simulation

1 Introduction

The emergence of new technologies has evolved in rural areas and agriculture information domain. Agent-based modeling and simulation (ABMS), as a part of distributed artificial intelligence, has developed rapidly since it arose from 1970s, and it was a popular direction of artificial intelligence now. Agent-based modeling and simulation currently provided methods and tools for solving complicated problems decision, and for setting up distributed, intelligent, integrated, and man-machine harmony decision making supporting system. In conclusion, ABMS has given us a new way to look at distributed systems and provided a path to more robust intelligent applications [1,2,3].

In recent years, ABMS theory and technology have rapidly developed. Olfati-Saber presented a theoretical framework for design and analysis of distributed flocking algorithms and provided a theoretical framework for analysis of consensus algorithms for gent network system Badjonski and Bentham had developed agent expert system for genetic breeding and management of crop production[4,5]. Agent-based modeling is intended to explore the relationship between observed spatial patterns and the process creating them（parker etal.2003）[6,7].

2 Material and Methodology

2.1 Indicator system of rural areas and agriculture information

11 country units from the overlay regions of Yellow River Delta high-efficiency ecological zone and blue economic zone of peninsula, including Dongying District, Shouguang City, Hanting District, Guangrao Country, Hekou District, Changyi City, Laizhou City, Kenli Country, Lijin Country, Wudi Country and Zhanhua Country in Shandong province. The comprehensive development of rural areas and agriculture information level in overlay country level is a crucial part of the National Demonstration Province of rural areas and agriculture information in the 11^{th} and 12^{th} Five-Year Plan of China. So agent simulation based on rural areas and agriculture information was obviously significance from the case study.

The system establishment of indicators was the premise of energy transmission mode of rural areas and agriculture information nodes, so we constructed the indicator system referred to the new countryside planning of socialism construction from the following principles of Development and Reform Commission of Shandong Province "developed production, affluent life, civilized rural atmosphere, clean and tidy village and democratic administration." Combined with the well-off indices from Wu Dianting (2006), the data were effectively collected and the selected 13 indices were applied in the study [6]. Six indices (Enger's coefficient, per house area of household, tap water countryside, household car, hospital numbers, urbanization) responded to the material life. Three indices reflected spiritual life (telephone communication countryside, cable television countryside, patents per year). Two indices were about income and distribution aspect, including per capita net income and per capita GDP. Population quality was reflected by 2 indices (students in middle school and per capita expenditure of education, science-technology and culture). As mentioned, the system of measurement indices was used to define the energy of rural areas and agriculture information nodes and explore the agent energy simulation process of rural areas and agriculture information level. Key steps were carried out to deal with the correlation data, including data acquisition, elimination dimension, determination of index weight, model establishment, comprehensive index computerization and comparison analysis, the results showed the weight values of 11 Informatization Nodes was 13.642(Dongying District), 4.592(Shouguang City), 2.456(Hanting District), 1.947(Guangrao Country), 1.678(Hekou District), 1.354(Changyi City),

0.707(Laizhou City) ,-0.576(Kenli Country), -2.249(Lijin Country), -2.358(Wudi Country), -2.879(Zhanhua Country), respectively.

2.2 Agent-based modeling

2.2.1 Construction of agent simulation project

The Repast-Simphony framework provided many other tools for assisting the model developer to create a model, but the standard model structure was based on these contexts and projections. Repast-Simphony was also a free and open source agent-based modeling toolkit that offers users a rich variety of features including the following content: an optional point-and-click model development environment, a pure Java point-and-click model execution environment, etc. The Repast S framework provided many other tools for assisting the model developer to create a model, but the standard model structure was based on these contexts and projections, so we selected Repast-Simphony program to clarify the agent simulation process [5,9-12].

InformationNode simulation in the paper responded to the development situation of rural areas and agriculture information. In this study, these nodes resources given as Informatization energy indicated the strength changes of rural areas and agriculture information. A large number of agents walked in the space, and constantly increased the energy by the method of learning from their around agents. Energy nodes of rural areas and agriculture information would be consumed in one cycle, so the energy from rural area and agriculture information node was consumed when it died. During the energy transmission, Informatization node agents transmitted in accordance with the established rules. The node process simulation of rural areas and agriculture information was explored from the dual policy in the study, the unsealed link and analysis was developed by agent simulation. Finally, we constructed the agent behavior model.

InformationNode model was now fully defined by Repast-Simphony IDE. It contained a definition for a single agent type, a network projection, and a grid projection. We created agent elements of “InformationNode”, the most often (and only) property and style are changed and the label property and enter “InformationNode” property was selected. 11 Informatization nodes, respectively, the energy of Informatization node had a certain change. Especially, in the case study, repast Simphony agent, the Math Operation for assigning a random number was selected as an important step, "Grid" and the dimensionality property is "2", and we defined the agent behavior according to the fundamental simulation steps, which included creating a “Deltademo” Model, creating a simple Repast model, running the simple Model, custom display properties, data sets and charts. Finally, the “delta_class” project was created, which included InformationNode agent, InformationNode groovy, etc.

2.2.2 Data processing and data analysis

To initialize the agent model was the first step of agent simulation process. When the model was initialized, agent parameter displays will be created and shown in the runtime window. Note that since no agent instances have been created yet, the simulation time would not run forward if the play button was pressed, as there were no scheduled actions. Agent instances may be created in the runtime window using the agent editor tool to connect the correlation nodes.

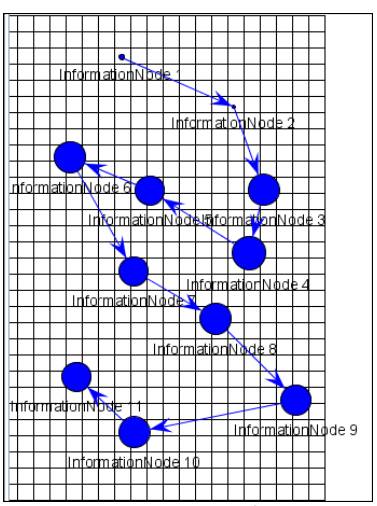
The agent behavior specified in this "Deltademo" was only reactive in nature, meaning that the agents would only do something based on a specific event occurring, in this case a reaction to a change in energy from an agent connected to it. The agents in the display can be probed by double clicking on them, and mainly the external response was inspected by the double-clicking mouse_event, implement of agent listen event, responded to the auto adapting.

3 Results and Analysis

The agent behavior that was defined should cause agents to connect to the first agent, and to change their energy property after 11 simulation ticks. Initialized program was carried out and the model run. Now the model can be run without first needing to make a change to an agent energy since the measured energy property was scheduled to be calculated every tick. Open the 2D Display, change the first Informatization Node's energy property to 100 and continue running the model. If the step simulation button was clicked until the tick count reaches 11, the next agent in the chain should change its energy from 300 to 200, to 100. Double click on the second agent to display its properties in the probe panel to verify this. Finally, run the model to observer the propagation of the change in energy to the downstream nodes. To test the chart, switch back to the 2D Display, probe an agent and change its energy from 300 to 200, to 100. Now run the simulation and observer, the energy changes were recorded on the chart.

The transmission mode was presented in Fig. 1 from the small value（from 100 to 200） to the high value, The transmission mode was presented in Fig. 2 from the middle value to high value(from 200 to 300), the kind of energy transmission mode was extracted from 11 country levels referred to Fig. 3.

The results from Fig. 5 showed that the energy of rural areas and agriculture information had an obvious gradient characteristics, which presented the dynamic changes of 11 Informatization Nodes located in the Yellow River Delta "and" the Blue Economic Zone of Peninsula". Each Informatization Node had changed characteristics itself, and the scope of Informatization energy had the certain rule from 100 to 300 on the whole, but there is the fluctuation characteristics round the threshold, such as 300,200,100 in the study case, respectively.



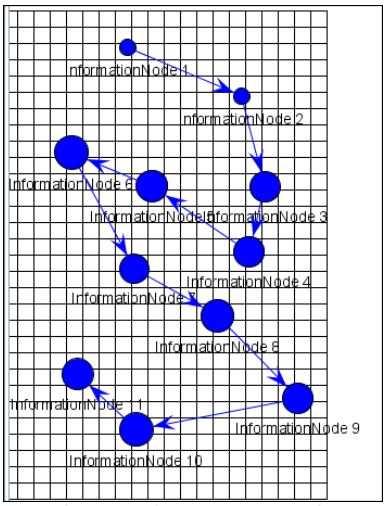


Fig. 1 Energy transmission mode of rural area and agriculture information (from 100 to 300) (left)
Fig. 2 Energy transmission mode of rural area and agriculture information (from 200 to 300) (right)

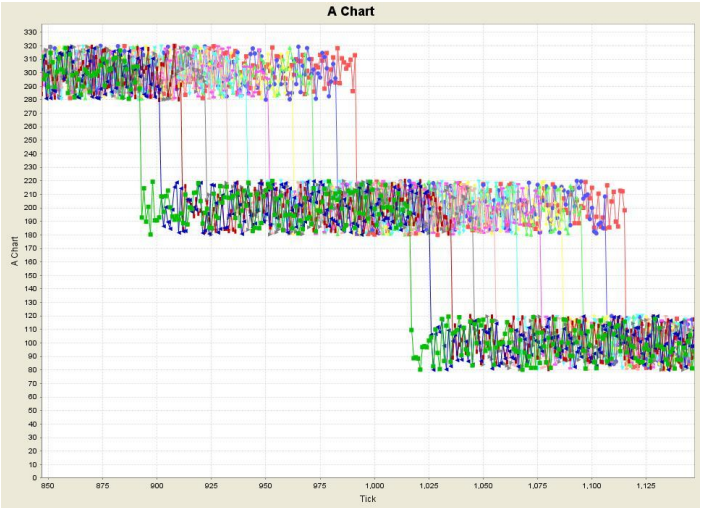


Fig. 3 The agent simulation based on Informatization energy transmission

4 Conclusions and Discussion

Agent-based simulation of rural areas and agriculture informatization was explored in the study, and some conclusions could be drawn as follows.

The paper proposed that the rural area and agriculture information level was measured by 13 indicators in the overlay 11 country levels located in case regions. The study constructed the energy nodes agents involved in agent context, network and grid of rural area and agriculture information. Furthermore, in dual policy mechanism

driving of “high-efficient ecological zone in Yellow River delta “and” the Blue Economic Zone of Peninsula”, we also developed that the spatial process of dissipation of energy of located in 11 informatization Nodes was obvious described by the agent simulation with Repast-S IDE, and analyzed the unsealed link among nodes. The article put forward the agent energy transmission mode from 11 informatization Nodes, the energy of rural areas and agriculture information has an obvious gradient characteristics, which presented the dynamic changes of 11 informatization Nodes; each informatization Node had change characteristics itself, but there was the fluctuation characteristics round the threshold, such as 300,200,100, respectively, which responded to the gradient changes of informatization energy transmission.

References

1 R. H. Bordini, M. Wooldridge, and J. F. Hübner , Programming multi-agent systems in agents peak using Jason (Wiley Series in Agent Technology), John Wiley & Sons,2007.

2 R.H. Bordini, M. Fisher, W. Visser, and M. Wooldridge, “Verifying Multi-Agent Programs by Model Checking”, J. Autonomous Agents and Multi-Agent Systems, 2006, 12(2), pp. 239–256.

3 Zhu Yeping, and Feng Zhongke, “Application of Agent in Agricultural & Forestry Economy Decision Support System”, Journal of Beijing Forestry University, 2005, pp. 218-221.

4 R.Olfati-Saber, “Flocking for multi-agent dynamic systems: algorithms and theory”, Automatic Control, IEEE Transactions on, 2006, 51(3), pp. 401-420.

5 Recursive Porous Agent Simulation Toolkit guide, 2012.

6 Parker, D.C., S.M. Manson, M.A.Jansscn, M.J. Hoffmann, and P.DCADMAN, 2003. “Multi-agent system for the simulation of land-use and land-cover change: a review”. Annals of the Association of American Geographers 93(2):314-317.

7 Kevin M. Johnston. Agent Analysis Agent-Based Modeling in ARCGIS. ESRI Press,Redlands/California.2013,

8 Liu Shihong. Study on the indicator system for measuring the rural area information level in China, Library And Information Service, 2007,51(9):33-35

9 Howe, T.R., N.T. Collier, M.J. North, M.T. Parker, and J.R. Vos, "Containing Agents: Contexts, Projections, and Agents," Proceedings of the Agent 2006 Conference on Social Agents: Results and Prospects,Argonne National Laboratory, Argonne, IL USA (September 2006).

10 North, M.J., P. Sydelko, J.R. Vos, T.R. Howe, and N.T. Collier, "Legacy Model Integration with Repast Simphony," Proceedings of the Agent 2006 Conference on Social Agents: Results and Prospects, ArgonneNational Laboratory, Argonne, IL USA (September 2006).

11 Parker, M.T., T.R. Howe, M.J. North, N.T. Collier, and J.R. Vos, "Agent-Based Meta-Models," Proceedingsof the Agent 2006 Conference on Social Agents: Results and Prospects, Argonne National Laboratory,Argonne, IL USA (September 2006).

12 Tatara, E., M.J. North, T.R. Howe, N.T. Collier, and J.R. Vos, "An Introduction to Repast Modeling by Using a Simple Predator-Prey Example," Proceedings of the Agent 2006 Conference on Social Agents:Results and Prospects, Argonne National Laboratory, Argonne, IL USA (September 2006).