Harmony of Agent System with Heterogeneity

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Abstract

This paper focuses on the integration of heterogeneous agents, also known as harmony of them, where heterogeneity emphasized so often. To advance the idea of heterogeneous agents, harmony of the agents, where homogeneity of the agent system turns into heterogeneity one at start, and then the heterogeneity turns back to homogeneity again after. Initiated from hybrid order agents, heterogeneity like social status, encapsulated agents will be introduced step by step. Finally, Chinese philosophy, which always inspires new ideas of thought, can be a good source of research topic. Conclusion that encapsulated agent is the capital Tao of agent systems was drawn from the paper.

Keywords: heterogeneous agents, homogeneity, harmony, lifting techniques, Chinese philosophy

1. Introduction

Agent systems initiated from engineering field not long ago, had been delved detail during the past several years [1-9]. Among them, the integrator agents, started with first order of them, followed by the second order ones. With the theory of agent came to mature gradually, people began to gaze the necessary of the difference of

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the agents, for in the real world systems, the individuals are so different that makes the world perfect.

The following of this note will be arranged as follows: Thrive of the heterogeneous agents will be provided at first, then followed by encapsulated agents which is the integration of the heterogeneous agents, can be the cell of the homogeneous agents, continued with harmony of the agents to advance the development, the last part will be conclusions.

2. Thrive of the heterogeneous agents

Thrive of the heterogeneous agents is driven from the requirement of the engineering.

2.1. *Thrive backed by engineering*

The earliest part of the heterogeneous agents is about hybrid order agents, which is comprised of first order dynamic agents and the second order dynamic agents. The first example of them is from electrical engineering, among electrical engineering, it is well known that we can have first order electric circuits and second order electric circuits. One resistor connected with another capacitor or inductor excited by added alternating circuit could be looked as the first order circuit, for this kind circuit, only one single pole stands there, their dynamics are too simple to be analyzed, the response of the output can be only uprising or downsizing. To be different from them, the second order circuit will be a little more complex, for the second order circuits, they have two energy storage elements, one resistor connected by capacitor and inductor simultaneously, the mathematical model of the second order circuit tells us that they have two different poles. In case of two different poles, oscillation between two of the storage elements can occur. However, protocol of the first order agents and the second order agents function not well to hybrid order agents easily. Take rendezvous as an example, in order to come to the same destination, extra damp argument must be introduced for the second dynamic agents, well for the first order agents, no such constraints is necessary. That is to say, when agents composed by different order agents, their collaborative protocols must also be hybrid.

2.2 *Encapsulated agents*

Homogeneous agent systems are favorite at its early stage of agent system research, and replaced by heterogeneous agent systems then after. Then there comes one question, is it possible to integrate two of them into whole? Is there any bridge between two of them? If the bridge exist, can the bridge bring some new breakthrough to the research of the agent systems?

To answer the urgent questions, we could not stop at homogeneity or heterogeneity, either. We should jump out all of them, from the very high standard to inspect all of them. Inspired by the encapsulated medicine for curing headache, fever, cold, influenza, or the other illness, let us start with Fig. 1, which describe the encapsulated agents.

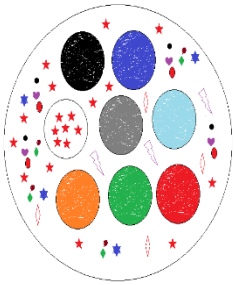

Fig.1 Encapsulated agents

Encapsulated agent is the agent that encapsulated by several hybrid agents, and these agents can be different in shape, in function, in sensing ability and in actuating strength. However, when encapsulated into a single cell, they become one specific agent, which demonstrates whole behavior of itself. To go to further, many of the encapsulated agents can scale up to a larger scale system of them. Fig. 2 gives us an example.

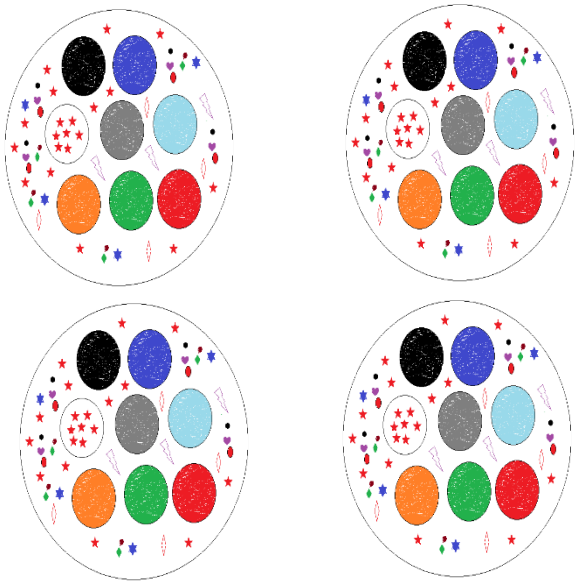

Fig.2 A large scale of the encapsulated system

Particle robotics based on statistical mechanics of loosely coupled components, demonstrated as this kind of example [10].

3 Harmony of the Agents

This part will contribute for harmony of the agents. Chines philosophy as a help, borrowed to understand this important problem.

3.1 Chines philosophy of harmony

As Chinese philosophy has explained: "Besides the tao of every class of things, there is another *Tao* for all things as a whole. In other words, besides the specific multiple tao, there is general unitary Tao which governs the production and transformation of all things. One Yang and one Yin: this is called the Tao. That which ensues from this is goodness, and that which is completed thereby is the nature. This is the Tao of the production of things, and such production is the major achievement of the universe. Everything can in one sense be Yang and in another sense Yin, according to its relation with other things. For instance, a man is Yang in relation to its wife, but Yin in relation to relation to his father. The metaphysical thing Yang which produces all things, however, can only be Yang, and the metaphysical Yin out of which everything is produced can only be Yin; this is called Tao, the Yin and Yang thus spoken of are Yin and Yang in the absolute sense" [11]. The above description of Chinese philosophy of tao and Tao, Yin and Yang can provides us a long time to go to dig out the truth of the harmony of the things in the world. Here, we can try to understand them in a simple way. When heterogeneous agent system was touched upon at first, the homogeneity also existed at the same time, and the reason why people could not see the homogeneity at that time is that the power of homogeneity is weaker than the heterogeneity. With the development of the agent systems, the heterogeneity became stronger and stronger, and the power of heterogeneity transcended the homogeneity, heterogeneous agent systems started to prevail then, almost the same, the second round cycling of heterogeneity homogeneity started again. At first several round of cycling, that can be the concrete examples of them, we can see them, we can touch them, we can decode of them easily. After a long time of cycling, there are so many cores and the cores of them can attract their surroundings, the concrete tao is not enough to deal with the complexity of them, then at this time the Tao must occur to direct the advancement of them.

3.2 *Encapsulated agent is the core of the agents*

From the description of the Chinese philosophy, it is not so arduous for us to get that the encapsulated agent is the core of the agents. We can declare that it is the encapsulated agent, which gives out a landmark for the development of the agent systems. Before appearance of encapsulated agents, we are wandering around heterogeneity and homogeneity of the agent systems, and after that, we feel so comfortable to accept both homogeneity and heterogeneity, for one of them can mean its counterpoint in Chinese philosophy of Yin and Yang, the capital tao of them, also known as Tao of the agent systems.

4 Conclusion

This note mainly contributes to clarify the following two points:

(1) That is the encapsulated agent that forces us to look back, it boils down to that homogeneity and heterogeneity can turn one into another;

(2) Chinese philosophy of Yin and Yang, tao and Tao are a real help for us to understand complex system of agents.

Of course, the Tao induced by time-delay, coupling, fragility, and robust property, is still attractive [12-15].

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