

Research on architecture of intelligent design platform for artificial neural network expert system

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Abstract. Based on the review of the development and current situation of CAD technology, the necessity of combination of artificial neural network and expert system, and then present an intelligent design system based on artificial neural network. Moreover, it discussed the feasibility of realization of a design-oriented expert system development tools on the basis of above combination. In addition, knowledge representation strategy and method and the solving process are given in this paper.

1 Introduction

After nearly 40 years of development, the traditional CAD technology has made great achievements in construction, machinery, electronics, ads and other fields. Because of the emergence of CAD technology, the desire of liberation from heavy and boring drawing and numerical calculation. However, with the continuous progress of science and technology, especially the rapid development of computer technology, people have put forward higher requirements to CAD technology. CAD technology is expected to generate ideas for automatically design and work as a designer, thereby reducing the dependence on man on the CAD process. So it is necessary to extend the traditional CAD system to be intelligent[4].

Intelligent CAD is a combination of CAD and artificial intelligence, that is, integrate knowledge processing system in original CAD system. Its purpose is to allow the computer to participate in the design process, to strengthen design automation. This is a very important direction of deepening of CAD technology in academic. Now, CAD expert system is mature and common, and the expert systems in many areas are very successful in practical application.

The success of expert system originated from that the solving of expert system is established based on expert knowledge in the field. But there are some problems, e.g., experts in any field do not always use rules to think. In this case, the expert system itself never really imitate human reasoning and neural network. However, neural network theory is a simplified method based on some functions of real neural system, and is put forward based on the research results of modern science. It reflects some characteristics of human brain function. Application of neural network in the design process has great importance on solving problems such as lacking design conditions, and has very broad application prospects. However, research of artificial neural network expert system is developed with the development of neural network[5].

2 Necessity of establishing artificial neural network expert system

Because there are many theoretical and technical problems such as knowledge representation, knowledge acquisition and difficult processing of large complex problems, and the similar technology of neural network has advantages of self-learning and fault-tolerant, adaptability, parallel architecture



and parallel processing capacity, but still has some inherent shortcomings, such as network complexity of connection model, instability of training process, long training time and difficult realization of network hardware. While hybrid artificial neural network expert system is the comprehensive utilization of the neural network method and the traditional methods of artificial intelligence. Expert system aims to deal with knowledge based on rules and to get logic reasoning; neural network is for processing insufficient knowledge and knowledge which is easy to change to associate, classify and recognize knowledge. Logic reasoning and imaginative thinking well cooperate with each other to form an organic whole, which combines notation system of artificial intelligence and neural network system based on neural network technology, and avoid their shortcomings. So it is a kind of expert system structure model with a very broad application prospect[2].

3 Design oriented intelligent platform

3.1 Combination way of expert system and neural network

For the combination way of expert system and neural network, we intend to use embedded structure, that is, artificial neural network as a module is embedded in the expert system, shown as Figure 1.

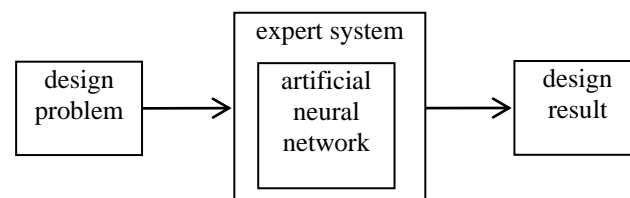


Figure 1: Combination way of expert system and neural network

In Figure 1, the function of the artificial neural network module is to transform the information gathered from the neural network module into the facts and rules needed by expert system. Conversion process is shown as Figure 2.

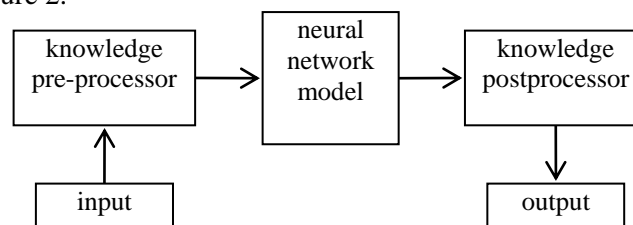


Figure 2: Knowledge conversion in neural network model

3.2 Figure structure of intelligent platform

The figure structure here refers to the common part of the expert system except knowledge base. Knowledge base, inference engine, global database, man-machine exchange interface, knowledge acquisition, interpretation mechanism, graphics processing are included in the whole structure. Due to the combination of the neural network technology, so some neural network modules exist in the system. Generally, they are universal, when we carry out specific design, just edit the problem into knowledge base according to certain description language. And then examine the obtained knowledge to get required expert system, in order to act design activity under certain situations. It usually is composed of expert system figure and knowledge base generation and management subsystem[1,3].

The following is the framework of our proposed intelligent platform architecture, shown as Figure 3.

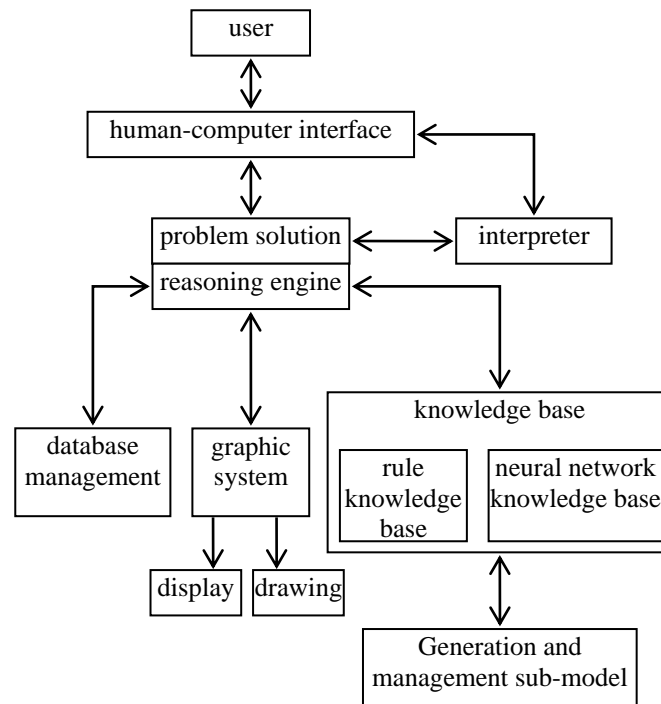


Figure 3: Architecture drawing

Notice:

1) The ideal intelligent supporting platform should be an expert system tool based on knowledge with high interactivity and visualization. It can provide a variety of knowledge representation, reasoning and graphics support database, knowledge base management system and flexible and friendly interface, so as to expand functions for different design problems to reach a high speed of design.

2) Neural network module is included in support platform, so as to improve the ability of studying arbitrary nonlinear complicated mappings by neural network. Grasping implicit knowledge in the field of learning problem is a more effective and natural method compared with artificial obtain of empirical knowledge. The obtain of neural network is not required by the knowledge engineers to organize, summarize and digest the knowledge of experts, but examples or instances used by experts to train the network, which can be obtained the most similar output with the answers given by experts on the condition of the same input.

3) Database management module is to manage the design results, and carry out inquire, browse and other operations towards design information, and provide data exchange and transmission.

4) According to current situation, the inference engine can solve the problems in problem field according to knowledge.

5) Generation and management subsystem of knowledge base is an important part of the tool:

a) Store the organized knowledge into the knowledge base according to the specific knowledge description language and human-computer interaction.

b) Examine structure and grammar on the completion of knowledge base to display error message and indicate the builders to modify

c) Dynamic reasoning debug towards knowledge base is completed by connection reasoning machine to do integration and consistency examination.

3.3 Design solution process

The design process of this system is to obtain design knowledge from design experts, including principle knowledge and expert experience into a knowledge base. Expert system initiate data, explore

the solution path heuristic design, simulating the process of expert, automatic the judgment to make decisions according to the design requirements to determine the parameters, finally given a direct or a reasonable target design for designers to choose, and the engineering diagram in the form of a basic design.

A general model was built for design solution. The all required data is got from the global database, the knowledge required from the rule base and the neural network module. When the user input information, knowledge base is inference according to certain strategy, at the same time show the reasoning conclusion. When the conclusion is correct, users can continue to work, and when the conclusion is inconsistent, users can interact to modify some parameters; users can use the knowledge in the knowledge base to determine the conclusion is correct or not. Repeat the process until the whole solution is accomplished, to display graphics system or drawing.

3.4 Knowledge processing method

The knowledge base is the core of the system, knowledge base in problem design phrase is divided into two parts: one is about the knowledge of design process, including the general design principle and human designer's experience. The other is about the knowledge of design object, that is, the part, structure, material, and utilization of design objects. The knowledge base consists of two parts; rule base and neural network knowledge base. For the problems in the field of clear and reliable; the knowledge provided by domain experts to the knowledge engineer, who will be responsible for knowledge representation of rules in the knowledge base. It is difficult to describe then, using neural network for knowledge acquisition. In a large number of experimental data and examples, neural network learning will store the general rules of data and examples in the network after learning. The network can produce the output that meets the requirements of the new experimental data and new cases.

4 Conclusion

At present, intelligence platform CAD workstation had been established in foreign countries to start the commercialization. But in the country has not formed the general design of intelligent CAD platform. With the popularity of CAD technology in the enterprise, CAD oriented design support platform will have a very broad application space. The architecture in this paper is established in this background. However, this system is a complex system, in the specific implementation will face many difficult problems in the field of intelligent CAD. If it is truly put into flexible and effective application to the production design, still need to make arduous efforts.

References

- [1] Chu Wenkui, Zhang Fengming, et al. "Research on the support of COTS-based military software", *Systems Engineering and Electronics*, 12, pp. 2166-2170, (2007).
- [2] Huang Yongkui. "Analysis and research on SAE AS4893 general open architecture (GOA) framework", *Avionics Technology*, 1, pp. 40-46, (2007).
- [3] Mei Hong, Shen Junrong. "Progress of research on software architecture", *Journal of software*, 6, pp. 1257-1275, (2006).
- [4] NATO. "STANAG4626-2005 modular and open avionics architecture (Part II: software)", Brussels: Military Agency for Standardization, (2005).
- [5] A.S.Wake. "Integrated Modular Avionics: Software Architecture Concept", Technical Report BAE-BSE-SP-RES-000009, (2003).