The Consensus of Uncertainties in Distributed Expert Systems

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Abstract

Due to limited knowledge, limited problem solving ability of single expert systems, or the uncertain features of problems and knowledge, different expert systems are required to cooperate to solve some complex problems in order to increase the reliability of the solution. If more than one expert system solves the same problem, each expert system may get a solution. The problem here is how to obtain the final uncertainty if more than one uncertainty for the same solution exists. The synthesis strategies are responsible for synthesizing the uncertainties of the solution ¿from different expert systems to produce the final uncertainty of the solution.

This paper deals with the consensus of uncertainties in distributed expert systems. It claims that the different uncertainties of a solution from different expert systems constitute not only a conflict case, but also non-conflict cases. We will refer both the conflict case and non-conflict cases as synthesis cases which are a conflict case, a partial overlap case, and a disjoint case. The first objective of this paper is to classify the synthesis *cases*, identify the *types* of distributed expert systems, and recognise the *relationships* among the different synthesis cases and the different types of distributed expert systems (M Zhang & C Zhang 1994b).

On the basis of this, a computational synthesis strategy is proposed to obtain a consensus of uncertainties in a conflict case. Within this strategy, the conflict case is further classified into two sub-cases, and two corresponding sub-strategies are proposed, in which both uncertainties and authorities are taken into consideration (M Zhang & C Zhang 1994a).

A synthesis strategy based on neural networks is also proposed in a conflict case (M Zhang & C Zhang 1995). In this strategy, as long as enough patterns have been obtained from human experts, neural networks can be trained to match all patterns. This strategy can simulate human experts reasonably well. Tests have also shown that a fixed neural network architecture can be used to solve conflict problems, with a variable number of inputs and outputs. That means only a small number of neural networks are required to solve all conflicts, thus the neural network can be used in real distributed expert systems.

Finally, a computational synthesis strategy is compared to a neural network synthesis strategy. Both strategies work well in different circumstances. A computational synthesis strategy has sound theoretical foundation. It can be applied in different distributed expert systems and different applied domains, especially when there is no enough patterns obtained from human experts. However, if there are enough patterns obtained from human experts, a neural network can simulate a conflict resolution method of human experts very well. In one word, the above two strategies compensate each other. Both strategies should be installed in one distributed expert system and different strategy is chosen based on different environment.

Further work will include the verification of the above two strategies by using real uncertainties in a real application field, such as medical diagnosis. We will also develop the strategies by using both a computational model and a neural network to solve the problems in the partial overlap synthesis case and disjoint synthesis case.

References

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