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Behavioral design to model a reactive decision of an expert in geothermal wells

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Abstract

Software design based on agents represents a new perspective for computer science and more specifically, for Artificial Intelligence. It is a new theory that has innovated the analysis, design and implementation of system software. The design of agents poses problems related with: (1) autonomous decision-making process, (2) co-ordination, (3) negotiation, and (4) handling of mental states and communication. In a reactive multi-agent system, the group of agents is subject continually to local changes. These changes are designed by means of behavior rules whose results are influenced by the behavior of the rest of the agents. The design of these rules is inspired by the biological or cognitive sciences. Particularly, the design of cognitive rules corresponds with the principle of rationality; its perspective is focused on the interaction among the agents. One of the objectives of artificial intelligence refers to the development of systems that ease or increase the level of comfort in the daily life of humans. Such is the case for tasks with permanent focus on the input data in convergent methods or systems that help in the decision-making process involved in costly processes. In this paper we propose a design's of the expert's decision-making process trough the use of a cognitive model, and fuzzy sets to model the agents' reactive deliberative process. Software system helps

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human expert in the estimation of the static formation temperatures. Furthermore, we will present an example based on a behavior developed from an expert in the field of geothermal sciences. The formulation of the human expert knowledge includes uncertainty, which is expressed in terms of fuzzy rules. An attempt to estimate formation temperatures from logged temperatures was solved whit this methodology based on reactive decision model. Thus, mathematically speaking an inverse problem is solved in this way. This paper describes and discusses the first experiences that form part of an incremental project whose final objective is to develop an expert system that allows the prediction of the degree of success of the drilling of geothermal wells.

Keywords: Cognitive models; Behavioral analysis; Reactive agents; Artificial Intelligence; Subjective domain; Autonomous action; Multi-agent architecture; Inverse problem; Geothermal wells; Temperature formation

1. Introduction

Software design has recently incorporated new perspectives from agents in the fields of computer science and specifically in the area of artificial intelligence (AI). This new theory is innovating the analysis, design and implementation of system software [1,25]. One of the problems with this methodology is that it exists few regarding the way in which the analysis and design is carried out. In addition, it is basically based on the designer's experience and the domain of the problem. In spite of these shortcomings, there are tools that are well defined and which contribute to the development of the analysis and design [2–4]. The important point with this new theory, is that it can model reactive behaviors based on agents and therefore complex problems of the real world, which means that specialized software located within the world would be loaded with uncertainty. These agents also have a grade of autonomy that allows them to reach their objectives. The elements used during the development of this work are introduced next.

1.1. Adaptive behavior

Autonomy is also known as adaptive behavior and it has the capacity to adjust itself to the environment conditions. According to Beer [22], it is the essence of the intelligence and it is the animal ability to fight continuously against the world; complex, dynamic and unpredictable. This ability is viewed in terms of flexibility to adjust the behavior compendium to the contingencies anytime as a product of the interaction with the environment. Our higher cognitive functions are our particular elaborations of this fundamental capacity and they are deeply linked to the adaptation ability.

On the other hand, when agents that simulate an adaptive behavior are developed, they may be done from two perspectives [23]: knowledge and automatic learning acquisition, or the domain expertise is codified from a human expert.