

HIERARCHICAL CONTROL IN A MULTIAGENT SYSTEM

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ABSTRACT. *Among alternative methodologies, an approach considering how distributed controllers can be employed in complex systems in a multiagent setting is developing widely. The hierarchical decomposition as a pervasive method to deal with undesirable computation allows for reduced computation, and provides solutions for larger and more complicated problems. However, there is a necessity for research efforts in the arrangement of local operational performance criteria to optimize the overall performance of a whole system. This paper uses the method described in our previous works on decision making based on simulated computed policy functions in a multiagent system. We propose that a multiagent system design for efficient control with hierarchical representation is closely related to agent modeling features. Considering the individual and social criteria while retaining the benefits of hierarchical coordination among agents, is the main challenge of this paper. An experimental study with a game model shows that systems, which is more sensitive in terms of computational resources, can take advantages of hierarchical control design, where individual and social criteria play significant role in the system design mechanism.*

Keywords: Multiagent system, Hierarchical structure, Problem decomposition

1. Introduction. Multiagent approach with hierarchically structured interagent coordination is represented in [1] as a pervasive method to deal with undesirable computation. In the work of [2], a hierarchical architecture with different levels of abstraction is considered as a good alternative method for advanced distributed control. Research on this approach mainly covers decomposing tasks, extracting primary features, minimizing interaction between subtasks and sharing common knowledge. [3] and [4] propose the framework which carries out dynamic problem decomposition and results in a network of small, but coupled subproblems. The subproblems in turn are solved by an agent network. This demonstrates the efficiency of this method with solution convergence for asynchronous agents' process. It is also noted in [5] that the use of hierarchical levels speeds up coordination skills in a multiagent system.

In the research works as cited above, the components structure of the hierarchy, their places in the hierarchy and the abstractions that are used, are decided upon in advance. Here, centralized control methods are demonstrated as being inefficient due to computational complexity, communication overhead and lack of scalability. Open issues are on balancing the task and structure complexities and dealing with efficient integration of a multiagent approach in system control design. There is a necessity for research effort in the arrangement of individual and social criteria, in order to define whether the system structure affects agent modeling.

In this paper, we use the method developed in our previous works. As described in [6], the main advantage of Policy Control in a Multiagent System (PCMA) algorithm is that,