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TWO-STRATEGY REINFORCEMENT EVOLUTIONARY ALGORITHM USING DATA-MINING BASED CROSSOVER STRATEGY WITH TSK-TYPE FUZZY CONTROLLERS

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Abstract. *This paper proposes a two-strategy reinforcement evolutionary algorithm using data-mining crossover strategy (TSR-EADCS) with a TSK-type fuzzy controller (TFC) for solving various control problems. The purpose of the R-EADCS is not only to improve the design of traditional reinforcement signal but also to determine the suitable rules in a TFC and the suitable groups that are selected to perform crossover operation. Therefore, this paper proposes a two-strategy reinforcement signal to improve the performance of the traditional reinforcement signal design and uses the data mining technique to find suitable fuzzy rules and groups for evolution. The proposed TSR-EADCS consists of both structure and parameter learning. In structure learning, the TSR-EADCS uses the self adaptive method to determine the suitability of TFC models between different numbers of fuzzy rules. In parameter learning, the TSR-EADCS uses the data-mining crossover strategy which is based on frequent pattern growth to select the suitable groups that are used to perform crossover operation. Illustrative examples are conducted to show the performance and applicability of the TSR-EADCS.*

Keywords: Fuzzy system, Control, Symbiotic evolution, Reinforcement learning, FP-growth

1. **Introduction.** Using fuzzy system to solve control tasks is greatly developed recently [1-6]. The reason is that classical control theory usually requires a mathematical model. Inaccurate mathematical modeling of plants usually degrades the performance of the controllers, especially for nonlinear and complex problems [7-10]. A fuzzy system consists of a set of fuzzy if-then rules. Conventionally, the selection of fuzzy if-then rules often relies on a substantial amount of heuristic observations to express the knowledge of proper strategies. Obviously, it is difficult for human experts to examine all the input-output data from a complex system to find proper rules for a fuzzy system. To cope with this difficulty, several approaches which generate if-then rules from numerical data have been proposed [2]. These methods were developed for supervised learning; that is, the correct "target" output values are given for each input pattern to guide the network's learning.

If the precise training data can be obtained easily, the supervised learning algorithm may be efficient in many applications. However, precise training data are usually difficult and expensive to obtain in real-world applications. As a result, there is a growing interest in reinforcement learning problems [11-13]. For reinforcement learning problems, training data are very rough and coarse, and they are only "evaluative" when compared with the "instructive" feedback in the supervised learning problem.

In reinforcement learning, a common-used algorithm is Barto and his colleagues' actor-critic architecture [11], which consists of a control network and a critic network. However,