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An improved reinforcement-immune algorithm for agricultural resource allocation optimization

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Highlights

In this paper, an improved reinforcement-immune algorithm (RIA) is proposed to realize an efficient and intelligent optimization in agricultural resource allocation and routing problem of the delivery vehicles. The main contributions of this paper are:

- We have established an agricultural resource allocation model, considering multiple dispersed fields which have demand for various resources and multiple supply centers with limited resources and delivery vehicles.
- By combining the strong self-adaptability and goal-driven performance of reinforcement learning with the antibody diversity and strong global search capability of immune optimization, the proposed RIA has better performance not only on the convergence property but also on the effectiveness of finding the optimal solution. First, we introduce Table Q as the action policy. Each element in Table Q means the action score that we choose delivery vehicle *v* to allocate resource *t* of supply center *s* to field *i*. Table Q is initialized according to the distance between the field and the supply center. Second, we update Table Q to learn good genetic information according to the optimal antibody after each iteration. Each antibody represents an allocation scheme. Third, at the stage of antibody mutation, we use Table Q to guide antibodies, which makes the algorithm adaptive and goal-driven.
- We use the proposed RIA to solve the agricultural resource allocation problem, giving a method of agricultural resource allocation to realize efficient and intelligent resource allocation with shortest total delivery distance and best economic benefits.

Abstract

Due to the decreasing and limited agricultural resources, developing techniques for agricultural resource allocation optimization has received increasing attention in recent years. In this paper, an improved reinforcement-immune algorithm (RIA) is proposed to realize an efficient and intelligent optimization in agricultural resource allocation and routing problem of the delivery vehicles. By combining the strong self-adaptability and goal-driven performance of reinforcement learning with the antibody diversity and strong global search capability of immune optimization, RIA has better performance not only on the convergence property but also on the effectiveness of finding the optimal solution. First, we introduce Table Q as the action policy. Each element in Table Q means the action score that we choose delivery vehicle *v* to allocate resource *t* of supply center *s* to field *i*. Table Q is initialized according to the distance between the field and the supply center. Second, we update Table Q to learn good genetic information according to the optimal antibody after each iteration. Each antibody represents an allocation scheme. Third, at the stage of antibody mutation, we use Table Q to guide antibodies, which makes the algorithm adaptive and goal-driven. Finally, simulation results illustrate that the proposed algorithm is effective in improving the climbing performance, searching ability and finding the optimal solution.

Keywords