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Research on Capacity-constrained Evacuation Route Planning Method in Large-scale Networks

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The study of large-scale population evacuation route planning is critical for such applications as disaster management and urban security. The key to emergency evacuation of sudden disaster events is to quickly generate evacuation route planning schemes. Efficient evacuation algorithms are necessary to obtain a scientific evacuation route planning scheme as soon as possible. At present, most of the researches focus on the optimal solution algorithm for evacuation route planning. The idea of this algorithm is to transform the evacuation path planning problem into the optimal solution of linear programming or the optimal solution of minimum cost flow on a static network. Due to the large amount of calculation, the algorithm has poor scalability, low efficiency, and is difficult to ensure practicability and maneuverability in large-scale network environment. Therefore, it is of practical significance to study the sub-optimal algorithm which can satisfy the requirements of emergency command and solve problems quickly. When the disaster occurs, the road network is likely to change, and the ideal evacuation routing algorithm should be able to generate more realistic and efficient routes in dynamic environment. The purpose of this paper is to obtain the optimal solution or sub-optimal solution of evacuation route planning problem as soon as possible, and to provide an effective route planning scheme for population evacuation and relief material transportation in emergency rescue. The concrete method is based on a heuristic CCRP algorithm to quickly solve the evacuation route planning problem of multi-source and multi-target, and find dynamic shortest path search based on Ant Colony algorithm. By adding a virtual source point connected to the actual road network, the capacity of the point is the total number of people to be evacuated, and the time of the point passing through the road network source point is zero. In this paper, the source points in the actual road network are treated as ordinary network nodes, and the multi-route constrained programming problem is transformed into a single-route constrained programming problem, which effectively reduces the redundancy in the algorithm and improves the operation efficiency. Experiment on actual road network data of different scales shows that this algorithm can not only quickly obtain the global approximate optimal solution in large network, but also is faster and easier to expand than the existing heuristic CCRP algorithm. Therefore, it can provide technical support for route planning of population evacuation and rescue.
Key words: Emergency rescue routing analysis; CCRP algorithm; Population evacuation