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Monte Carlo Tree Search improved Genetic Algorithm for unmanned vehicle routing problem with path flexibility

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ABSTRACT

With the gradual normalization of the COVID-19, unmanned delivery has gradually become an important contactless distribution method around China. In this paper, we study the routing problem of unmanned vehicles considering path flexibility and the number of traffic lights in the road network to reduce the complexity of road conditions faced by unmanned vehicles as much as possible. We use Monte Carlo Tree Search algorithm to improve the Genetic Algorithm to solve this problem, first use Monte Carlo Tree Search Algorithm to compute the time-saving path between two nodes among multiple feasible paths and then transfer the paths results to Genetic Algorithm to obtain the final sequence of the unmanned vehicles fleet. And the hybrid algorithm was tested on the actual road network data around four hospitals in Beijing. The results showed that compared with normal vehicle routing problem, considering path flexibility can save the delivery time, the more complex the road network composition, the better results could be obtained by the algorithm.

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Izvirni znanstveni članek

Izboljšan genetski algoritem z drevesnim preiskovanjem Monte Carlo za problem usmerjanja avtonomnih vozil s prilagodljivostjo poti

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POVZETEK

S postopno normalizacijo COVID-19 je dostava z avtonomnimi vozili vse pomembnejša metoda brezstične distribucije na Kitajskem. V tem prispevku preučujemo problem usmerjanja avtonomnih vozil ob upoštevanju prilagodljivosti poti in števila semaforjev v cestnem omrežju, s ciljem zmanjšanja zapletenosti cestnih razmer, s katerimi se soočajo avtonomna vozila. Za izboljšanje genetskega algoritma za rešitev tega problema uporabimo algoritem drevesnega preiskovanja Monte Carlo. Najprej uporabimo drevesno preiskovanje Monte Carlo za izračun poti, ki prihrani čas med dvema vozliščema pri več izvedljivih poteh, nato pa rezultate prenesemo v genetski algoritem, da dobimo zaporedje flote avtonomnih vozil. Hibridni algoritem je bil preizkušen na dejanskih podatkih o cestnem omrežju v okolici štirih bolnišnic v Pekingu. Rezultati so pokazali, da z upoštevanjem prilagodljivosti poti skrajšamo čas dostave v primerjavi z običajnim problemom usmerjanja vozil in da, bolj, kot je zapletena sestava cestnega omrežja, boljše rezultate doseže algoritem.

PODATKI O ČLANKU

Ključne besede:
Avtonomno vozilo;
Prilagodljivost poti;
Problem usmerjanja vozil;
Genetski algoritem (GA);
Drevesno preiskovanje Monte Carlo (MCTS);
COVID 19;
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