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A two-stage construction heuristic approach for vehicle routing problem with split deliveries and pickups: Case studies and performance comparison

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ABSTRACT

The vehicle routing problem with split deliveries and pickups is a hot research topic in recent years, where a customer can be served multiple times with split deliveries and pickups. The objective is to minimize the travel distance, use the fewest number of vehicles and increase the load rate, which will further reduce the carbon emissions that damage the environment. In this paper, we use a two-stage construction heuristic approach to solve this problem. First, partitioning algorithms based on the multi-restart-iterative sweep algorithm are adopted to partition the customer domain into sub-domains according to the vehicle capacity, and to determine the split points and the corresponding values. Second, a modified Clarke-Wright savings algorithm is used to check the possibility of each point in each route based on the load of each point and the vehicle load limitation. The three case studies with 12 instances per each from the reconstructed Solomon benchmark datasets were conducted to evaluate the effectiveness and feasibility of the proposed approaches-Unsplit, Both-Split and Enhanced-Both-Split. The comparison among these approaches reveals that the splits reduce the total travel cost and vehicles used, and increase the average loading rate considerably, especially when customers have larger demand values. Our computation results proves that the vehicle routing problem with split deliveries and pickups is highly beneficial for transportation and logistics enterprises.

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Dvostopenjski konstrukcijski hevristični pristop za problem usmerjanja vozil z razdeljenimi dostavami in prevzemi: Študije primerov in primerjava zmogljivosti

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POVZETEK

Problem usmerjanja vozil z razdeljenimi dostavami in prevzemi, pri čemer je dostava k stranki z razdeljenimi dostavami in prevzemi lahko izvedena večkrat, je vroča tema raziskav v zadnjih letih. Cilj je zmanjšati potovalno razdaljo, uporabiti čim manjše število vozil in povečati stopnjo obremenitve vozila, kar zmanjša okolju škodljive emisije ogljika. V tem prispevku za rešitev problema uporabimo dvostopenjski konstrukcijski hevristični pristop. Najprej so, za razdelitev domene stranke na poddomene, glede na zmogljivost vozila ter za določitev točk delitve in ustreznih vrednosti, uporabljeni algoritmi za razdelitev, ki temeljijo na iskalnem algoritmu s ponavljajočim se večkratnim zagonom. Nato je, za preverjanje dosegljivosti vsake točke na vsaki poti, glede na obremenitev vsake točke in omejitev obremenitve vozila, uporabljen spremenjen Clarke-Wrightov varčevalni algoritem. Za oceno učinkovitosti in izvedljivosti predlaganih pristopov – Unsplit (nedeljeno), Both-Split (oba deljena) in Enhanced-Both-Split (izboljšano oba deljena) so bile izvedene tri študije primerov, vsaka z 12 primeri iz rekonstruiranih primerjalnih podatkovnih nizov Solomon. Primerjava med temi pristopi razkriva, da delitve zmanjšajo skupne potovalne stroške in število uporabljenih vozil ter znatno povečajo povprečno stopnjo nakladanja, zlasti kadar je več povpraševanja. Rezultati naših izračunov dokazujejo, da je problem usmerjanja vozil z razdeljenimi dostavami in prevzemi zelo pomembna za transportna in logistična podjetja.

PODATKI O ČLANKU

Ključne besede:
Usmerjanje vozil;
Razdeljene dostave in prevzemi;
Dvostopenjska konstrukcijska hevristika;
Najprej združevanje v gruče in kasneje usmerjanje;
Algoritmi za razdelitev;
Spremenjeni Clarke-Wrightov varčevalni algoritem

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