

Optimization of disassembly line balancing using an improved multi-objective Genetic Algorithm

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ABSTRACT

Disassembly activities take place in various recovery operations including remanufacturing, recycling, and disposal. Product disassembly is an effective way to recycle waste products, and it is a necessary condition to make the product life cycle complete. According to the characteristics of the product disassembly line, based on minimizing the number of workstations and balancing the idle time in the station, the harmful index, the demand index, and the number of direction changes are proposed as new optimization objectives. So based on the analysis of the traditional genetic algorithm into the precocious phenomenon, this paper constructed the multi-objective relationship of the disassembly line balance problem. The disassembly line balance problem belongs to the NP-hard problem, and the intelligent optimization algorithm shows excellent performance in solving this problem. Considering the characteristics of the traditional method solving the multi-objective disassembly line balance problem that the solution result was single and could not meet many objectives of balance, a multi-objective improved genetic algorithm was proposed to solve the model. The algorithm speeds up the convergence speed of the algorithm. Based on the example of the basic disassembly task, by comparing with the existing single objective heuristic algorithm, the multi-objective improved genetic algorithm was verified to be effective and feasible, and it was applied to the actual disassembly example to obtain the balance optimization scheme. Two case studies are given: a disassembly process of the automobile engine and a disassembly of the computer components.

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Optimizacija uravnoveženja demontažne linije z uporabo izboljšanega večkriterijskega genetskega algoritma

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POVZETEK

Demontaža je prisotna v različnih postopkih obnove, vključno s ponovno izdelavo, recikliranjem in odstranjevanjem. Demontaža izdelka je učinkovit način recikliranja odpadkov in je nujen pogoj za krožen življenjski cikel izdelka. Glede na značilnosti demontažne linije, ki temelji na zmanjševanju števila delovnih postaj in uravnoveženju časa nedejavnosti postaje, so kazalnik škodljivosti, kazalnik povpraševanja in število sprememb smeri predlagani kot novi cilji optimizacije. Na podlagi analize tradicionalnega genetskega algoritma ta članek obravnava problem uravnoveženja demontažne linije kot večkriterijski. Problem uravnoveženja demontažne linije spada med NP-težke probleme. Inteligentni optimizacijski algoritmi kažejo odlične lastnosti pri reševanju takšnih problemov. Glede na značilnosti tradicionalne metode reševanja problema uravnoveženja demontažne linije, kjer je bil rezultat rešitve en sam in ni mogel izpolniti številnih meril uravnoveženja, je bil za rešitev modela predlagan izboljšan večkriterijski genetski algoritem s hitrejšo konvergenco. Na podlagi primera demontaže, je bil izboljšan večkriterijski genetski algoritem v primerjavi z obstoječim heurističnim algoritmom z enim samim ciljem potrjen kot učinkovit in izvedljiv ter je bil uporabljen na dejanskem primeru demontaže. Podani sta dve študiji primera, in sicer postopek demontaže avtomobilskega motorja in demontaža računalniških komponent.

PODATKI O ČLANKU

Ključne besede:

Montaža;
Demontaža;
Uravnoveženje linije;
Večkriterijska optimizacija;
Ponovna izdelava;
Obnova izdelka;
Življenjski cikel izdelka;
NP-težki problemi;
Izboljšan genetski algoritem

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