A layered genetic algorithm with iterative diversification for optimization of flexible job shop scheduling problems

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ABSTRACT

Flexible job shop scheduling problem (FJSSP) is a further expansion of the classical job shop scheduling problem (JSSP). FJSSP is known to be NP-hard with regards to optimization and hence poses a challenge in finding acceptable solutions. Genetic algorithm (GA) has successfully been applied in this regard since last two decades. This paper provides an insight into the actual complexity of selected benchmark problems through quantitative evaluation of the search space owing to their NP-hard nature. A four-layered genetic algorithm is then proposed and implemented with adaptive parameters of population initialization and operator probabilities to manage intensification and diversification intelligently. The concept of reinitialization is introduced whenever the algorithm is trapped in local minima till predefined number of generations. Results are then compared with various other standalone evolutionary algorithms for selected benchmark problems. It is found that the proposed GA finds better solutions with this technique as compared to solutions produced without this technique. Moreover, the technique helps to overcome the local minima trap. Further comparison and analysis indicate that the proposed algorithm produces comparative and improved solutions with respect to other analogous methodologies owing to the diversification technique.

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Večplastni genetski algoritem s ponavljalno diverzifikacijo za optimizacijo problema fleksibilnega terminiranja proizvodnje po naročilu

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POVZETEK

Problem prilagodljivega terminiranja proizvodnje po naročilu (FJSSP) je razširitev klasičnega problema terminiranja proizvodnje po naročilu (JSSP). Znano je, da je FJSSP NP-težki optimizacijski problem, kar predstavlja glavni izziv pri iskanju sprejemljivih rešitev. Genetski algoritem (GA) se za reševanje takšnih problemov uporablja že zadnji dve desetletji. Ta prispevek obravnava kompleksnost izbranih standardnih testnih primerov s kvantitativnim vrednotenjem prostora rešitev, ki je vzrok njihove NP-težke narave. Za inteligentno upravljanje intenziviranja in diverzifikacije je predlagan in uporabljen štiriplastni genetski algoritem s prilagodljivimi parametri za inicializacijo populacije in prilagodljivimi verjetnostmi operatorjev GA. Koncept ponovne inicializacije se uvede vsakič, ko se algoritem ujame v lokalni minimum, preden doseže vnaprej določeno število generacij. Rezultate, dobljene s predlaganim algoritmom za standardne testne primere, smo primerjali z rezultati, dobljenimi z drugimi evolucijskimi algoritmi. Ugotovljeno je bilo, da predlagani GA z iterativno diverzifikacijo najde boljše rešitve v primerjavi z rešitvami, pridobljenimi brez predlaganega pristopa. Poleg tega ta pristop pripomore, da se reševanje ne konča v lokalnem minimumu. Nadaljnja analiza in primerjava s konkurenčnimi metodologijami kažeta, da predlagani algoritem, zaradi tehnične diverzifikacije, najde primerljive in boljše rešitve.

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PODATKI O ČLANKU

Ključne besede:

Terminiranje;
Prilagodljivo terminiranje proizvodnje po naročilu (FJSSP);
Kompleksnost;
Raznolikost;
Kombinatorna optimizacija;
Genetski algoritem

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