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Dynamic scheduling in the engineer-to-order (ETO) assembly process by the combined immune algorithm and simulated annealing method

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ABSTRACT

With the increasing demand for customization, the engineer-to-order (ETO) production strategy plays an increasingly important role in today's manufacturing industry. The dynamic scheduling problem in ETO assembly process was investigated. We developed the mathematical model to represent the problem. In order to reduce rescheduling frequency, we introduced the concept of starting time deviation and improved the rolling horizon driven strategy. We proposed the hybrid algorithm combining immune algorithm (IA) and simulated annealing (SA) with the minimization of the rescheduling cost as the objective. The IA was designed as the global search process and the SA was introduced to improve the local searching ability. The scenario-based approach was used to model the disruptions affecting the tasks to be executed. Performance of the rolling horizon driven strategy and the hybrid algorithm were evaluated through simulations, the experiment analysis showed the best parameters of rolling horizon methods and demonstrated the feasibility of the hybrid algorithm. The hybrid algorithm was tested on different scale benchmark instances and the case that collected from a steam turbine assembly shop. The quality of solution in terms of cost obtained by the hybrid algorithm was found superior to the other three algorithms proposed in the literature.

ARTICLE INFO

Keywords:
Engineer-to-order (ETO);
Assembly process;
Dynamic scheduling;
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Immune algorithm;
Simulated annealing

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Izvirni znanstveni članek

Dinamično načrtovanje izdelave po naročilu (ETO) v postopku montaže s kombiniranim imunskim algoritmom in simuliranim ohlajanjem

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POVZETEK

Z naraščajočim povpraševanjem po prilagoditvi ima strategija izdelave po naročilu (ETO) vse pomembnejšo vlogo v današnji industriji. Preučen je bil problem dinamičnega načrtovanja proizvodnje za ETO v postopku montaže. Za predstavitev problema smo razvili matematični model. Da bi zmanjšali frekvenco načrtovanja, smo uvedli koncept odstopanja po začetnem času in izboljšali strategijo kotaleče obzorja. Predlagali smo hibridni algoritem, ki združuje imunski algoritem (IA) in simulirano ohlajanje (SA) s ciljem zmanjšanja stroškov reprogramiranja. IA je bil zasnovan kot globalni iskalni postopek, SA pa je bil vključen za izboljšanje lokalne iskalne sposobnosti. Za modeliranje motenj, ki vplivajo na naloge, ki jih je treba izvesti je bil uporabljen pristop, ki temelji na scenarijih. Učinkovitost strategije kotaleče obzorja in hibridnega algoritma, smo ocenili s simulacijami, analiza eksperimenta pa je razkrila najboljše parametre metode kotaleče obzorja in potrdila izvedljivost hibridnega algoritma. Hibridni algoritem je bil preizkušen na različnih standardnih testnih primerih in na primeru montaže parnih turbin. V primerjavi s tremi algoritmi, predstavljenimi v literaturi, je kakovost rešitve glede na stroške, pridobljena s hibridnim algoritmom, boljša.

PODATKI O ČLANKU

Ključne besede:
Izdelava po naročilu (ETO);
Montaža;
Dinamično načrtovanje;
Reprogramiranje;
Kotaleče obzorje;
Imunski algoritem;
Simulirano ohlajanje

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