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An improved multi-objective firefly algorithm for integrated scheduling approach in manufacturing and assembly considering time-sharing step tariff

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ABSTRACT

Today, energy conservation and reduction of consumption are crucial concerns for manufacturing companies. Current research on integrated scheduling of processing and assembly typically focuses only on equipment resources and processing and assembly processes. A new method for energy-saving integrated scheduling in workshops has been proposed, which incorporates the recently introduced time-of-use tiered electricity prices into the scheduling optimization model. This method also introduces an operation strategy of turning equipment on and off during idle periods. A multi-objective mathematical model was developed to minimize energy consumption and assembly delay time in the processing and assembly processes. Due to the complexity of the model, the standard firefly algorithm was improved when used to solve the model. This involved designing a three-layer encoding method and two decoding methods, and providing detailed steps of the algorithm. Using a mixed flow production line as an example, the final scheduling solutions were obtained through model construction and algorithm solving, taking into account the tiered electricity price. The results of the example demonstrate that parallel processing and assembly effectively reduce assembly delay costs, and the implementation of the on/off strategy reduces power consumption during the machining process.

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Manufacturing and assembly;
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Izvirni znanstveni članek

Izboljšan večkriterijski algoritem kresničk za celovit pristop k terminiranju v proizvodnji in montaži z upoštevanjem cene pri časovni porazdelitvi korakov

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POVZETEK

Varčevanje in zmanjševanje porabe energije sta danes za proizvodna podjetja ključnega pomena. Trenutne raziskave o celovitem načrtovanju obdelave in montaže se običajno osredotočajo le na vire opreme ter procese obdelave in montaže. Predlagana je bila nova metoda za energetsko varčno načrtovanje terminiranja v delavnicah, ki v model optimizacije terminiranja vključuje nedavno uvedene časovno vezane cene električne energije. Ta metoda uvaja tudi strategijo delovanja, ki vključuje vklop in izklop opreme v času mirovanja. Razvit je bil večkriterijski matematični model za minimiziranje porabe energije in časa zamude pri montaži v postopkih obdelave in montaže. Zaradi zapletenosti modela je bil standardni algoritem kresničk izboljšan. To je vključevalo zasnovo triplastne metode kodiranja in dveh metod dekodiranja ter zagotovitev podrobnih korakov algoritma. Na primeru proizvodne linije z mešanim tokom so bile končne rešitve za načrtovanje dobljene z izgradnjo modela in reševanjem algoritma, pri čemer je bila upoštevana stopenjska cena električne energije. Rezultati primera kažejo, da vzporedna obdelava in montaža učinkovito zmanjšata stroške zamud pri montaži, izvajanje strategije vklop/izklop pa zmanjša porabo električne energije med postopkom obdelave.

PODATKI O ČLANKU

Ključne besede:
Varčevanje z energijo;
Celovito terminiranje;
Proizvodnja in montaža;
Cena za časovno porazdelitev korakov;
Strategija preklopa;
Algoritem kresničk;
Večkriterijski model

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