An integrated system for scheduling of processing and assembly operations with fuzzy operation time and fuzzy delivery time

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A B S T R A C T

This paper integrates the processing scheduling with assembly scheduling, aiming to satisfy the requirements for just-in-time (JIT) production. Considering the uncertainty of time factors in actual production, the operation time of the jobs were represented as triangular fuzzy numbers and the delivery time of the final product as trapezoidal fuzzy numbers. An extended job-shop scheduling problem (JSP) considering above factors was proposed in this paper. A mathematical model was established for processing and assembly scheduling, aiming to achieve the mean satisfaction degree on delivery time. In light of the complexity of the problem, a genetic algorithm (GA) was designed to realize the fuzzy integrated optimization of processing and assembly under uncertainty. The proposed algorithm includes selection, crossover, mutation operations, and reflects the spirits of two-section real number encoding and elite protection strategy. Each part of the GA was designed in detail. Finally, the proposed model and algorithm were verified through a case study on processing and assembly scheduling. The model enjoys high practical value by taking the customer satisfaction of the delivery period as the main goal. The results show that our scheduling strategy mirrors the actual production situation and provides a good reference for JSP scheduling under multiple uncertainties. The best solution obtained by our model is more feasible than basic JSP in real production environment.

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Integrirani sistem za razporejanje izdelave in montaže z mehkim časom izdelave in mehkim dobavnim rokom

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POVZETEK

Ta članek združuje razporejanje izdelave z razporejanjem montaže, da bi zadovoljili zahtevam po sprotni proizvodnji (JIT). Če upoštevamo negotovost časovnih dejavnikov v dejanski proizvodnji, je bil čas izdelave predstavljen kot trikotno mehko število, dobavni rok končnega izdelka pa kot trapezno mehko število. V tem prispevku je bil, glede na zgoraj navedene dejavnike, predlagan razširjen problem terminiranja proizvodnje po naročilu (JSP). Vzpostavljen je bil matematični model za razporejanje izdelave in montaže, s ciljem doseči povprečno stopnjo zadovoljstva z ozirom na čas dobave. Glede na kompleksnost problema je bil zasnovan genetski algoritem (GA), ki omogoča mehko integrirano optimizacijo izdelave in montaže z upoštevanjem negotovosti. Predlagani algoritem vključuje mehanizme izbire, križanja, mutacije, dvosektorskega realnega številčnega kodiranja in ohranjanja elitistične strategije. Vsak del GA je bil zasnovan podrobno. Nazadnje sta bila predlagani model in algoritem preverjena s študijo primera razporejanja izdelava in montaže. Model ima visoko praktično vrednost, saj kot glavni cilj upošteva zadovoljstvo kupcev z ozirom na čas dobave. Rezultati kažejo, da naša strategija razporejanja odraža dejanske proizvodne razmere in nudi dobro referenco za JSP z več negotovostmi. Najboljša rešitev, ki jo dobimo z našim modelom, je v realnem proizvodnem okolju izvedljivejša od rešitve osnovnega JSP.