Scheduling optimization of a flexible manufacturing system using a modified NSGA-II algorithm

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ABSTRACT

The Flexible Manufacturing System (FMS) belongs to the class of production systems in which the main characteristic is the simultaneous execution of several processes and sharing a finite set of resources. Nowadays, FMS must attend to the demands of market needs for personalized products. Consequently the life-cycle of a product tends to be shorter and a greater variety of products must be produced in a simultaneous manner. The FMS considered in this work has 16 CNC machine tools for processing 80 varieties of products. Since the minimizing of a machine's idle time and thus the minimizing of total penalty costs are contradictory objectives, the problem has a multi-objective nature. The objective of this research was to develop a modified non-dominated sorting genetic algorithm (NSGA-II) for multi-objective optimization. The research will then evaluate and discuss the performance of the modified NSGA-II against the original NSGA-II. The existing NSGA II has been modified in order to improve the global optimal front and reduce the computational effort. The result has been compared with the existing NSGA-II, cuckoo search (CS), particle swarm optimization algorithm (PSO), etc. and it was found that the proposed approach was superior.

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Optimizacija terminiranja opravil v prilagodljivem obdelovalnem sistemu z uporabo modificiranega algoritma NSGA-II

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POVZETEK

Glavna značilnost prilagodljivega obdelovalnega sistema (angl. Flexible Manufacturing System – FMS) je hkratno izvajanje številnih izdelovalnih postopkov in skupna raba omejenega števila proizvodnih virov. FMS mora slediti zahtevam trga, ki so usmerjene k individualizaciji izdelkov. Zaradi tega se skrajšuje življenjski cikel izdelka, poleg tega pa se hkratno izdeluje v vedno več različicah. V delu obravnavamo FMS, ki ga sestavlja 16 CNC-strojev, ki so namenjeni za izdelavo 80 različic izdelkov. Ker sta minimizacija časa, ko stroj ne dela in zatorej minimizacija celotnih stroškov nasprotujoči si zahtevi, ima problem večkriterijsko naravo. Cilj pričujočega dela je bil razviti modificiran genetski algoritem, temelječ na nedominiranem razvrščanju (NSGA-II), s katerim smo rešili omenjen problem večkriterijske optimizacije. Modifikacije izvirnega algoritma se nanašajo predvsem na izboljšanje globalne optimalne fronte in skrajšanje potrebnega časa obdelave. V raziskavi je narejena tudi primerjava zmogljivosti modificiranega algoritma NSGA-II z izvirno metodo NSGA-II, poleg tega pa še z metodami kukavičje iskanje (angl. Cuckoo Search – CS), optimizacijo z rojem delcev (angl. Particle Swarm Optimization – PSO) itd. Ugotovili smo, da predlagan pristop daje boljše rezultate od preostalih metod.

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PODATKI O ČLANKU

Ključne besede:

Prilagodljivi obdelovalni sistem
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Algoritem NSGA-II
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