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A multi-criteria decision-making in turning process using the MAIRCA, EAMR, MARCOS and TOPSIS methods: A comparative study

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ABSTRACT

Multi-criteria decision-making is important and it affects the efficiency of a mechanical processing process as well as an operation in general. It is understood as determining the best alternative among many alternatives. In this study, the results of a multi-criteria decision-making study are presented. In which, sixteen experiments on turning process were carried out. The input parameters of the experiments are the cutting speed, the feed speed, and the depth of cut. After conducting the experiments, the surface roughness and the material removal rate (MRR) were determined. To determine which experiment guarantees the minimum surface roughness and maximum MRR simultaneously, four multi-criteria decision-making methods including the MAIRCA, the EAMR, the MARCOS, and the TOPSIS were used. Two methods the Entropy and the MEREC were used to determine the weights for the criteria. The combination of four multi-criteria making decision methods with two determination methods of the weights has created eight ranking solutions for the experiments, which is the novelty of this study. An amazing result was obtained that all eight solutions all determined the same best experiment. From the obtained results, a recommendation was proposed that the multi-criteria making decision methods and the weighting methods using in this study can also be used for multi-criteria making decision in other cases, other processes.

ARTICLE INFO

Keywords:
Turning;
Material removal rate (MRR);
Surface roughness;
Multi-criteria decision-making (MCDM);
Multi Attributive Ideal-Real Comparative Analysis (MAIRCA);
Evaluation by an Area-based Method of Ranking (EAMR);
Measurement of Alternatives and Ranking according to Compromise Solution (MARCOS);
Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS);
Entropy;
Method based on the Removal Effects of Criteria (MEREC)

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Večkriterijsko odločanje v procesu struženja z metodami MAIRCA, EAMR, MARCOS in TOPSIS: Primerjalna študija

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POVZETEK

Večkriterijsko odločanje je pomembno in vpliva na učinkovitost procesa mehanske obdelave in tudi na ta postopek na splošno. Večkriterijsko odločanje pomeni določanje najboljše alternative med mnogimi alternativami. V tej študiji so predstavljeni rezultati študije večkriterijskega odločanja. Pri tem je bilo izvedenih šestnajst eksperimentov procesa struženja. Vhodni parametri eksperimentov so bili rezalna hitrost, podajalna hitrost in globina reza. Po izvedbi eksperimentov smo določili površinsko hrapavost in stopnjo odstranjevanja materiala (MRR). Da bi ugotovili, kateri eksperiment hkrati zagotavlja najmanjšo površinsko hrapavost in največjo MRR, so bile uporabljene štiri večkriterijske metode odločanja: MAIRCA, EAMR, MARCOS in TOPSIS. Za določitev uteži za kriterije sta bili uporabljeni dve metodi, entropija in MEREC. Kombinacija štirih večkriterijskih metod odločanja z dvema metodama določanja uteži je ustvarila osem nivojev vrednotenja rešitev eksperimentov, kar je novost te študije. Dosežen je bil izjemen rezultat, saj je vseh osem nivojev vrednotenja potrdilo isti eksperiment kot najboljši. Na podlagi rezultatov je bilo predlagano priporočilo, da se metode večkriterijskega odločanja in metode temeljitega presojanja, uporabljene v tej študiji, lahko uporabijo tudi za večkriterijske odločitve v drugih primerih in pri drugih procesih.

PODATKI O ČLANKU

Ključne besede:
Struženje;
Stopnja odstranjevanja materiala (MRR);
Hrapavost površine;
Večkriterijsko odločanje (MCDM);
Primerjalna analiza več atributov idealno-realno (MAIRCA);
Vrednotenje po območni metodi razvrščanja (EAMR);
Merjenje alternativ in razvrščanje glede na kompromisno rešitev (MARCOS);
Tehnika razvrstitev preferenc po podobnosti z idealno rešitvijo (TOPSIS);
Entropija;
Metoda, ki temelji na učinkih odstranitve kriterijev (MEREC)

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