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Drilling process optimization by using fuzzy-based multi-response surface methodology

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ABSTRACT

In this study, a fuzzy mathematical model is developed using a multi-response surface methodology with fuzzy logic to optimize all response variables simultaneously. The model has the flexibility to weight the response factors depending on the decision maker's choices. The model has been applied to the drilling process using a high speed steel drill bit on PVC samples in an upright drill. The aim of the study is to minimize surface roughness and cutting forces. The input variables and their experiment intervals are determined as cutting speed (360-1080 rev/min), feed rate (0.10-0.30 mm), and material thickness (15-45 mm). Surface roughness, radial force-X and radial force-Y are chosen as response variables. According to the experiments and statistical analysis, the optimum levels of cutting speed, feed rate, and material thickness were calculated as 1068 rev/min, 0.1195 mm, and 21.33 mm respectively.

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Izvirni znanstveni članek

Optimizacija vrtanja z uporabo metodologije večkriterijske odzivne površine, temelječe na mehki logiki

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POVZETEK

V prispevku je razvit matematični model, ki z metodologijo večkriterijske odzivne površine in mehke logike optimira vse kriterijske spremenljivke hkrati. Model je prilagodljiv in prepušča obtežitev kriterijskih faktorjev odločevalcu. Model je bil uporabljen pri vrtanju z visoko hitrostnim svedrom za jeklo na PVC vzorcih v pokončni postavitvi. Namen raziskave je bil zmanjšati površinsko hrapavost in rezalne sile. Izbrane vhodne spremenljivke in njihovi eksperimentalni intervali so bili: rezalna hitrost 360-1080 vrt/min, podajanje 0.10-0.30 mm, debelina materiala pa 15-45 mm. Izbrane kriterijske spremenljivke so bile površinska hrapavost in radialni sili v smereh X in Y. Z eksperimenti in statistično analizo ugotovljeni optimalni vrtalni pogoji so bili pri rezalni hitrosti 1068 vrt/min, podajalni hitrosti 0.1195 mm in debelini materiala 21.33 mm.

PODATKI O ČLANKU

Ključne besede:
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Rezalne sile
Mehka logika
Metodologija večkriterijske odzivne površine

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