Modeling and optimization of finish diamond turning of spherical surfaces based on response surface methodology and cuckoo search algorithm

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ABSTRACT

Surface roughness is one of the most significant factors to indicate the product quality. Diamond turning is an efficient and highly accurate material removal process to improve the surface quality of the workpiece. In the present study, the arithmetic mean absolute roughness (R_a) and total height of profile (R_t) of spherical surface during finish turning of a commercial brass alloy CuZn40Pb2 were modeled using Response Surface Methodology (RSM). The experimental investigations were carried out using the Central Composite Design (CCD) under dry conditions. The effect of cutting parameters such as spindle speed, feed rate and depth of cut on spherical surface quality was analyzed using analysis of variance (ANOVA). A cuckoo search (CS) algorithm was used to determine the optimum machining parameters to minimize the surface roughness. Finally, confirmation experiments were carried out to verify the adequacy of the considered optimization algorithm.

ARTICLE INFO

Keywords:

Brass alloy;
Diamond turning;
Surface roughness;
Spherical surface;
Modeling;
Optimization;
Response surface methodology (RSM);
Cuckoo search (CS)

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Article history:

Received 31 May 2021
Revised 3 September 2021
Accepted 15 September 2021

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Modeliranje in optimizacija finega struženja sferičnih površin z diamantno konico orodja na podlagi metodologije odzivne površine in algoritma kukavičjega iskanja

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POVZETEK

Površinska hrapavost je eden najpomembnejših dejavnikov, ki označujejo kakovost izdelka. Struženje z diamantno konico je učinkovit in zelo natančen postopek odstranjevanja materiala za izboljšanje kakovosti površine obdelovanca. V tej študiji sta bili aritmetično povprečje absolutne hrapavosti (R_a) in skupna višina profila (R_t) sferične površine med finim struženjem komercialne medeninaste zlitine CuZn40Pb2 modelirani z metodologijo odzivne površine (RSM). Eksperimentalne raziskave so bile izvedene z uporabo centralne kompozitne zasnove (CCD) v suhih pogojih obdelave. Učinek rezalnih parametrov, kot so hitrost vretena, podajanje in globina reza na kakovost sferične površine je bil analiziran z analizo variance (ANOVA). Za določitev optimalnih obdelovalnih parametrov za zmanjšanje hrapavosti površine je bil uporabljen algoritem kukavičjega iskanja (CS). Na koncu so bili izvedeni potrditveni poskusi, da bi preverili ustreznost predlaganega optimizacijskega algoritma.

PODATKI O ČLANKU

Ključne besede:

Medeninasta zlitina;
Struženje z diamantno konico;
Hrapavost površine;
Sferična površina;
Modeliranje;
Optimizacija;
Metodologija odzivne površine (RSM);
Kukavičje iskanje (CS)

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Zgodovina članka:

Prejet 31. maja 2021
Popravljen 3. septembra 2021
Sprejet 15. septembra 2021

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