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Artificial neural network modeling for surface roughness prediction in cylindrical grinding of Al-SiC_p metal matrix composites and ANOVA analysis

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A B S T R A C T

In the present work, surface roughness prediction model in cylindrical grinding of LM25/SiC/4_p metal matrix composites (MMC) was developed using artificial neural network (ANN) methodology. The independent input machining parameters considered in the modeling were wheel velocity, feed, work piece velocity and depth of cut. The neural network architecture 4-12-1 with logsig transfer function was found optimum with 94.20 % model accuracy. The analysis of variance (ANOVA) was carried to study influence of the machining parameters on surface roughness. The study revealed higher *F*-ratio for wheel velocity and it found to be the most influencing parameter in prediction of surface roughness. The percentage of contribution for wheel velocity was 32.47 %, feed was 26.50 % and work piece velocity was 25.08 %. The depth of cut was found to have least effect on surface roughness with 13.22 % contribution. The independent and combined effect of process parameters on predicted value of surface roughness was studied using two-dimensional graphs and surface plots. The study showed that surface roughness increases as feed increases while it decreases with increase in wheel velocity. It was also observed that minimum surface finish could be obtained at high wheel and work piece velocities, and low feed and depth of cut.

A R T I C L E   I N F O

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Izvirni znanstveni članek

Napovedovanje in analiza površinske hrapavosti pri cilindričnem brušenju Al-SiC$_p$ kompozitov s kovinsko osnovo s pomočjo umetnih nevronskih mrež in metodo ANOVA

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P O V Z E T E K

V prispevku je bil razvit model za napovedovanje površinske hrapavosti pri cilindričnem brušenju LM25/SiC/4$_p$ kompozitov s kovinsko osnovo s pomočjo umetne nevronske mreže (angl. Artificial Neural Net – ANN). Neodvisni vhodni obdelovani parametri pri modeliranju so bili hitrost vrtenja brusnega koluta, podajanje, hitrost obdelovanca in globina reza. Za najboljšo zasnovo nevronske mreže se je izkazala arhitektura 4-12-1 z *logsig* aktivacijsko funkcijo. Takšna arhitektura je omogočila natančnost napovedi 94.20 %. Z metodo analize variance (ANOVA) je bila narejena študija vpliva obdelovalnih parametrov na površinsko hrapavost. Visoko *F*-razmerje za hitrost vrtenja brusnega koluta je pokazalo, da ta vhodni parameter najbolj vpliva na hrapavost. Odstotni prispevki vpliva vhodnih parametrov na hrapavost so bili: hitrost vrtenja brusnega koluta 32.47 %, podajanje 26.50 % in hitrost obdelovanca 25.08 %. Izkazalo se je, da je globina reza najmanj vplivna in prispeva na površinsko hrapavost le v obsegu 13.22 %. S pomočjo dvodimenzionalnih in površinskih grafov je bil analiziran vpliv kombiniranih procesnih parametrov na vrednost površinske hrapavosti. Ugotovljeno je bilo, da se površinska hrapavost povečuje, ko se povečuje podajanje, a znižuje, ko narašča hitrost vrtenja brusnega koluta. Prav tako je bilo ugotovljeno, da je najkakovostnejšo površino mogoče dobiti pri visokih hitrostih vrtenja brusnega koluta in visokih hitrostih obdelovanca ter nizkih vrednostih za podajanje in globino reza.

P O D A T K I O Č L A N K U

Ključne besede:
Kompoziti s kovinsko osnovo
Cilindrično brušenje
Površinska hrapavost
Umetne nevronske mreže
Analiza variance

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