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Development of family of artificial neural networks for the prediction of cutting tool condition

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ABSTRACT

Recently, besides regression analysis, artificial neural networks (ANNs) are increasingly used to predict the state of tools. Nevertheless, simulations trained by cutting modes, material type and the method of sharpening twist drills (TD) and the drilling length from sharp to blunt as input parameters and axial drilling force and torque as output ANN parameters did not achieve the expected results. Therefore, in this paper a family of artificial neural networks (FANN) was developed to predict the axial force and drilling torque as a function of a number of influencing factors. The formation of the FANN took place in three phases, in each phase the neural networks formed were trained by drilling lengths until the drill bit was worn out and by a variable parameter, while the combinations of the other influencing parameters were taken as constant values. The results of the prediction obtained by applying the FANN were compared with the results obtained by regression analysis at the points of experimental results. The comparison confirmed that the FANN can be used as a very reliable method for predicting tool condition.

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Izvirni znanstveni članek

Razvoj družine umetnih nevronskih mrež za napovedovanje stanja rezalnega orodja

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POVZETEK

V zadnjem času se za napovedovanje stanja orodij poleg regresijske analize vse bolj uporabljajo umetne nevronske mreže (ANN). Kljub temu simulacije ANN, naučenih na različnih načinih rezanja, vrstah materiala, oblikah vijačnega svedra (TD) in dolžinah rezalnega roba svedra za napoved osne vrtalne sile in navora, niso dosegle pričakovanih rezultatov. Zato je bila v tem prispevku razvita družina umetnih nevronskih mrež (FANN) za napovedovanje osne sile in navora pri vrtanju v odvisnosti od številnih vplivnih dejavnikov. Oblikovanje FANN je potekalo v treh fazah. V vsaki fazi so se nastale nevronske mreže učile na vrtalni dolžini, dokler se sveder ni obrabil in na spremenljivem parametru, medtem ko so bile kombinacije drugih vplivnih parametrov nespremenljive. Rezultate napovedi, pridobljene z uporabo FANN, smo primerjali z rezultati, pridobljenimi z regresijsko analizo v točkah, pridobljenih s pomočjo eksperimentalnih rezultatov. Primerjava je potrdila, da je FANN mogoče uporabiti kot zanesljivo metodo za napovedovanje stanja orodja.

PODATKI O ČLANKU

Ključne besede:
Vrtanje;
Rezalno orodje;
Svedri za vrtanje;
Osna sila;
Obraba orodja;
Napoved;
Umetne nevronske mreže;
Vzvratno razširjanje

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