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A new approach for product quality prediction of complex equipment by grey system theory: A case study of cutting tools for CNC machine tool

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ABSTRACT

To compete in total global market, product quality has attracted the attention of manufacturers as an important mean of product differentiation. As effective product quality prediction method is the key technology for quality control system, a new prediction model and calculation method inspired by the grey system theory is proposed in this paper. Our practical evaluation shows that the quality of complex equipment was improved. Firstly, a new method of grey forecasting model for complex equipment was proposed, and the principle and method of grey predictive model with several variables were introduced. Secondly, this article discussed grey system theory model and showed how to use it in the forecasting process. Then, the quality prediction model and method using grey theory were set up with quality characteristics of cutting tools for Computer Numerical Control (CNC) machine tool. Finally, analysis of the test system showed that the applied predicting model and method were feasible and effective. This new method is also applicable to predict product quality of other complex electromechanical products which are composed a number of systems and subsystems.

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Izvirni znanstveni članek

Nov pristop za napovedovanje kakovosti izdelkov zapletene opreme s teorijo sivih sistemov: Študija primera rezalnega orodja za CNC obdelovalne stroje

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POVZETEK

Za doseganje konkurenčnosti na svetovnem trgu so proizvajalci prepoznali kakovost kot pomembno sredstvo za diferenciacijo izdelkov. Ker je učinkovita metoda napovedovanja kakovosti izdelkov ključna tehnologija pri nadzoru kakovosti, sta v tem prispevku predlagana nov model napovedovanja in metoda izračuna, ki temelji na teoriji sivih sistemov. Naše praktično vrednotenje kaže, da se je kakovost zapletene opreme izboljšala. Najprej je bila predlagana nova metoda sivega napovedovanja za zapleteno opremo, uvedena pa sta načelo in metoda sivega napovedovalnega modela z več spremenljivkami. V članku je obravnavan model teorije sivih sistemov in prikazana je uporaba v postopku napovedovanja. Nato sta bila model napovedovanja kakovosti in metoda s sivo teorijo uporabljena s kakovostnimi značilnostmi rezalnega orodja za računalniško krmiljen (CNC) obdelovalni stroj. Analiza testnega sistema je pokazala, da sta uporabljeni model in metoda napovedovanja izvedljiva in učinkovita. Predlagana metoda je uporabna tudi za napovedovanje kakovosti drugih zapletenih elektromehanskih izdelkov, ki so sestavljeni iz več sistemov in podsistemov.

PODATKI O ČLANKU

Ključne besede:
Nadzor kakovosti;
Računalniško numerično krmiljenje (CNC);
Obdelovalni stroj;
Napoved kakovosti;
Teorija sivih sistemov

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