MODELS IN MACHINING

Stanislav CHOVANEC, Zdenko LIPA

Authors: ***Stanislav Chovanec, MSc., Zdenko Lipa, Prof. PhD.***
Workplace: ***Department of Machining and Assembly, Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology Bratislava***
Address: ***J. Bottu 23, 917 24 Trnava, Slovak Republic***
Phone: ***+421 907 603 807***
Email: ***stanislav.chovanec@stuba.sk , zdenko.lipa@stuba.sk***

Abstract

To study phenomena aside the success of the theory can be used for modeling. Our contribution presents some possible and some of the methods used for modeling the machining process. We present our models for the determination of cutting forces in drilling for example.

Key words

technology, model, machining, parameters, physical dimensions

Introduction

Modeling theory in recent years has been very successful in many areas of research materials and technologies. In this respect, is no less machining technology. Modeling may examine interdependencies accompanying phenomena during operation. Linked to this is that the intended movement phenomena (cutting forces, cutting temperature, etc.) are actually physical phenomena. With the well can then be related to transfer and generalization of the results of experiments on a series of similar physical phenomena. It deals with the theory of similarity.

Based on a series of experiments to judge the behavior of a series of similar machines or devices. We then simplified models (picture) to study the basic features of the forthcoming work (the model).

The basic thesis of the theory of similarity

The founder of the theory of similarity was Isaac Newton, he is entitled under the law of similarity, which states that the two phenomena are similar if they are characterized by the same dimensionless parameters. Free dimensional parameters of the model works or can be obtained with the two variables share the same physical dimensions. Non-dimensional these parameters are called theories of similarity criterion of similarity. Problems that have a common non-dimensional description (non-dimensional same parameters) and each corresponding to a (so-called homologous) non-dimensional parameters are the same size, called physically similar. Whatever the model parameters are $x_1, x_2,...x_n$ and let the work parameters are $x_1', x_2',...x_n'$ then is: $x_1'=c_1x_1$, $x_2'=c_2x$,...$x_n'=c_nx_n$ a $c_1,c_2,...c_n$ are the coefficients of similarity. The coefficients of similarity must still meet the fact that these similarities in the pattern and work are the same.

Model and work are structurally similar, though each element and each link corresponds to the model explicitly (homologous) binding element that works. If this is not the case (only the relationship of model to work), then the model and the work is structural and therefore homomorphous model is simplified compared to the work.

The tabulation dimensionless similarity criteria and a work flow model, called model laws. If the model consists of measures of length $l_1, l_2,...l_n$ and angular rates $\alpha_1, \alpha_2,... \alpha_n$, and work on measures of length $l_1',l_2',...l_n'$ and angular rates $\alpha_1', \alpha_2',.... \alpha_n'$, then

$$\frac{l_2}{l_1} = \frac{l_2'}{l_1'} = C_l \qquad \text{and} \qquad \frac{l_2'}{l_2} = \frac{l_1'}{l_1} = C_l \qquad \text{and} \qquad \frac{\alpha_1'}{\alpha_1} = C_2$$

but we know from geometry, that similar units have identical angles, then $C_\alpha = 1$ if ω the angular velocity and t is time, then

$$\alpha = \omega \, . \, t \qquad \text{and} \qquad \alpha' = \omega' \, . \, t'$$

and since $\alpha = \alpha'$

then $\omega \, . \, t = \omega' \, . \, t'$

and $\frac{t'}{t} = \frac{\omega}{\omega'}$ the condition homochrons (if the model choose t, ω and work ω' , we must work for the time t′ calculated).

Applications of machining technology

Relationships for calculating the movement of selected phenomena in machining can also be regarded as models. We have theoretical models (chose variables involved and between them analyze their interaction and exposure to find the variable expressing the equation) and empirical (if we find an experimental operation, and also expresses the equation). So we have a theoretical (deterministic) model of cutting forces, surface roughness under cultivation, cutting temperature and the like.

And we have an empirical (statistical) model of cutting forces, surface roughness under cultivation, cutting temperature and the like. As shown by the theoretical model of cutting force F the differential equation (we drafted)

$$\frac{dF}{d\beta_1} + \frac{\cos\gamma_0}{\cos(\beta_1-\gamma_0)\cdot\sin\beta_1}\cdot F = \frac{f.a_p\cdot d}{\sqrt{3^{n+1}}}\left[\cot g\beta_1 + tg(\beta_1-\gamma_0)\right]^n \cdot \left(\frac{\cos^2(\beta_1-\gamma_0)-\sin^2\beta_1}{\sin^3\beta_1\cdot\cos(\beta_1-\gamma_0)\sin\varphi}\right)$$

and we also give empirical model (again we found) F_0 axial cutting forces in drilling.

$$F_0 = 2260 \cdot \left(\frac{d}{10}\right)^{0,941} \cdot \left(\frac{f}{0,16}\right)^{0,726} \cdot \left(\frac{v_c}{15,7}\right)^{-0,076}$$

where β_1 the marginal angle of deflection,
γ_0 tooling is orthogonal angle head,
f the displacement,
a_p the depth of cut,
d the drill bit diameter,
φ is the angle of friction,
n the exponent (the so-called relationship Ludwik).

Conclusion

The present contribution is based on the application of the principles of modeling in machining points out that modeling has its application in machining. The work was created under the grant VEGA 1/4111/07 implementation of differential and other mathematical methods in analytical theory machining.

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