Tool Life Modelling In Continuous Variable Speed Turning

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Abstract

In this paper, a generalized tool life model that considers nonstationary cutting was developed. In particular, the model was conceived for predicting the life of the tool when Spindle Speed Variation *SSV*, one of the most effective techniques for suppressing regenerative chatter vibrations, is used. The proposed formulation takes into account the main cutting parameters and the parameters associated to the *SSV*. A dedicated experimental campaign of turning tests was carried out and the data were used to develop the model. A proper validation was even carried out performing additional tool life tests. It was found that the generalized formulation can be used for predicting the tool life both at constant spindle machining *CSM* and adopting *SSV* within the maximum estimating error of 6%.

Full Text

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Figures

Figure 1

Experimental set-up: lathe and developed control unit

Figure 2

Tracking errors RV A = 0:3 freq = 1Hz: A_Ω set and A_Ω meas

Figure 3

Workpiece hardness analysis - effects of the position

Figure 4

Micro-hardness measurements

Figure 5

Flank wear land analysis: average flank width computation VBB_{ik}

Figure 6

Example of the evolution of the average flank wear evolution VBB_{ik} of the i^{th} test

Figure 7

CSM: residuals analysis

Figure 8

V BBik evolution: effect of SSSV on TL in the intermediate cutting conditions

Figure 9

SSSV formulation: residuals analysis

Figure 10

General model scheme: initial experimental scheme (left) - resulted test representation and validation test conditions (right)

Figure 11

General residuals analysis