OPTIMAL TUNING OF THE TWO-DEGREE-OF-FREEDOM SYSTEM

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Performance of any machine tool is, under certain technological conditions, limited by chatter, which occurs during machining. The limit between machining without and with chatter is called limit of stability. It is expressed by so called stable depth of cut, which is defined under certain conditions. The article deals with the investigation of optimal modal parameters for machine tool models. The criterion for this optimum is the highest limit of stability.

Key words: *machine tool, chatter, stability, performance, optimization*

1. Introduction

Optimization of modal parameters for the two-degree-of-freedom system seams to be very primitive task. But, if it is done in the context of machine tool performance, the task becomes much more complicated. It has been shown that for analysis of the dynamic properties the machine tool structure can be simplified up to the two-degree-of-freedom system, [1]. Experiments show that the majority of milling, turning and grinding machines has frequency response function, measured at tool, in which two modes are dominated. The optimal tuning of natural frequencies, damping and stiffness is important for our ability of stability limit increase. The high stability limit is one of the basic suppositions of the high machine tool performance.

The concept of tuning is understood as set up of the particular relation of natural frequencies of the system. But in our case, damping and also modal stiffness will be tuned. Except the modal parameters, so-called direction factors and Tobias phase are going to be tuned.

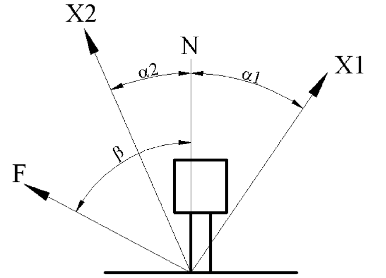

Fig.1: Starting model of a machine tool with two modes

2. Starting model

The starting model is shown in Fig. 1. The scheme represents a tool, which can vibrate in the two directions X_1 and X_2 or modes respectively. The two modes of vibration contain with the line N, which is normal to the machined surface, angles α_1 and α_2. The cutting force F contains with the normal line N angle β. The case has been solved using the method of frequency response function (FRF).

For our purpose, only the vibration of direction N is interesting. Therefore, the vectors X_1 and X_2

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