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DYNAMICS ASPECT OF CHATTER SUPPRESSION IN MILLING

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Every model of milling process is non-smooth by nature because a cutting tool has several cutting blades, which are in contact with a workpiece during some time intervals of cutting. For the rest of time, tool blades are away from the workpiece. This causes discontinuities, which make difficulties in numerical simulations and analytical solutions, as well. Harmful vibrations in cutting processes, known as chatter, are generated by modulations of chip thickness, which in turn produce the cutting force variation. This mechanism is the most powerful source of chatter. Since the regeneration mechanism was firstly identified by Tobias [4] as well Tlusty and Polacek [3] in the 1960s, there has been a great deal of research which has been aimed to provide methods for enhancing the process stability of machining systems. The most logical and widely used approach has been to optimize the cutting conditions by determining the so-called stability lobe diagram (SLD) for an increase in productivity. Here, alternative active method is proposed. In a new approach chatter avoidance is realized by additional external excitation acting on the workpiece. In consequence, regenerative chatter vibrations should be suppressed. Such a model is described by differential equations of motion with time delay (delay differential equations, DDEs) [1, 2]. From practical point of view, a pursuit of chatter avoidance is a very important task. Therefore, we propose to analyse the system's dynamics numerically using bifurcation diagrams, where the eternal excitation parameters are chosen as key parameters. Moreover, the effect of smoothing of the force characteristic is studied here. Finally, some practical conclusions for cutting process have also been drawn from this study.

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