Investigation of the dynamics of the vibratory drilling process with control over the range of oscillations

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The article reports that chip control can be provided by communicating to the drill of harmonic oscillations in the direction of the axis of rotation. Chip control is one of the necessary conditions for ensuring the quality of the deep drilling process in the manufacture of parts from hard-to-digest metals and alloys. A possible way to maintain these oscillations is to replace the drill chuck with a special vibration shaker, including an elastic element that allows the tool to move in the axial direction. With the correct choice of the rigidity of the elastic element and the processing conditions, the excitation of self-oscillations of the drill by the regenerative mechanism is possible. It is advisable to supplement this mechanism with the control action determined in the feedback loop and providing the characteristics of the process required for chip control in a wide range of processing parameters. The paper offers an algorithm for adaptive control of the dynamics of the vibratory drilling process, in which the additional influence on the oscillating system proportional to the axial speed of the drill is set and the feedback coefficient in the adaptation loop based on the comparison of the current value of the swing amplitude and its target value is determined. The simulation of the dynamics of a closed nonlinear system "elastic system-workflow-control system" for various processing modes and properties of the processed material, for cases of absence and management availability is carried out. The influence of the feedback gain on the quality of the controlled process is investigated. It is advisable to supplement the developed control algorithm with recommendations for assigning a target value for the range of axial oscillations of the cutting edges that ensures chip control.

Keywords: *vibratory drilling, chip control, auto-oscillations, regenerative mechanism, adaptive control, nonlinear dynamics*

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