

Theoretical Analysis and Numerical Simulation of the Static and Dynamic Characteristics of Hydrostatic Guides Based on Progressive Mengen Flow Controller

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Abstract: The oil film thickness of oil hydrostatic guide with constant pressure supply based on capillary restrictor is greatly affected by load, and this kind of hydrostatic guide is usually applied to the machine tools with moderate load. The static and dynamic characteristics of the guide have been studied by using some theoretical, numerical and experimental approaches, and some methods and measures have been proposed to improve its performances. The hydrostatic guide based on progressive mengen (PM) flow controller is especially suitable for the heavy numerical control (NC) machine tools. However, few literatures about the research on the static and dynamic characteristics of the hydrostatic guides based on PM flow controller are reported. In this paper, the formulae are derived for analyzing the static and dynamic characteristics of hydrostatic guides with rectangle pockets and PM flow controller according to the theory of hydrostatic bearing. On the basis of the analysis of hydrostatic bearing with circular pocket, some equations are derived for solving the static pressure, volume pressure and squeezing pressure which influence the dynamic characteristics of hydrostatic guides with rectangle pocket. The function and the influencing factors of three pressures are clarified. The formulae of amplitude-frequency characteristics and dynamic stiffness of the hydrostatic guide system are derived. With the help of software MATLAB, programs are coded with C++ language to simulate numerically the static and dynamic characteristics of the hydrostatic guide based on PM flow controller. The simulation results indicate that the sensitive oil volume between the outlet of the PM flow controller and the guide pocket has the greatest influence on the characteristics of the guide, and it should be reduced as small as possible when the field working condition is met. Choosing the oil with a greater viscosity is also helpful in improving the dynamic performance of hydrostatic guides. The research work has instructing significance for analyzing and designing the guide with PM flow controller.

Key words: PM flow controller, rectangle pocket, static characteristics, dynamic characteristics, hydrostatic guides

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