

REGRESSION ANALYSIS OF COUPLING EFFECTS OF THERMAL AND EXTERNAL FORCES ON A PRECISION MACHINE CENTER

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ABSTRACT

The thermal, gravity, and external load in the upward direction on the spindle of a machine center and their coupling effects are studied in the paper. The finite element method is used to calculate the variety of combination of load-displacement and load-stress results, then regression algorithm is used to get corresponding equations. As long as the regression equations for certain kinds of machine center are obtained, then substitute temperature and load into these equations, the result will be obtained. No tedious finite element calculation should be done repeatedly, so that a tremendous amount of time will be saved. To shorten the developing time is to reduce cost and increase competition. Four cases are studied: (1) External load on the spindle without considering temperature rising and gravity force; (2) External load on spindle as well as gravity force on machine center, but no temperature rising; (3) Temperature rising at the spindle with gravity force; (4) Temperature rising, gravity force and external load on the spindle coupling together. The corresponding regression equations are recommended for the future use. The regression surfaces are also given for the coupling of temperature and loading case to give designers a guidance in their machine center design.

KEYWORDS: Machine Center, Regression Analysis, Coupling Effects