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Design High Speed Spindle Cooling System Using Novel Solid-Fluid Coupling Heat Transfer Computational Scheme

De-Shin Liu, Kuo-Liang Cheng, Zhen-Wei Zhuang, T. C. Lee

Summary

High speed spindle is the key component for high precision machine center. The optimum design of spindle cooling system have to achieve to avoid the high heat produce by the build-in motor that can make great damage to the spindle bearing systems. This paper presents a new solid-fluid coupling computing method for design high speed spindle cooling system. Energy equation has been formed for a control volume within the cooling channel to describe the heat absorbing by the coolant moving in a constant speed. Finite different method is applied to solve temperature rising in the coolant and coupled with a 3-D finite element structure heat transfer program which can solve temperature distribution due to heat produce from build-in motor. An experimental testing setup is using to verify this solid-fluid coupled program. The numerical results agree well with experimental data. The effectiveness of straight heat-pipe-type cooling system and helical heat-pipe-type cooling system are compared by applied this methodology. The numerical methods developed in this research can offer the spindle designer a new tool to improve spindle cooling system design.