Development of Calculation Technique for FEM Thermal Simulation Using Virtual Fluid Elements Instead of FVM Fluid Simulation

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ABSTRACT

In recent years, CAE (Computer aided engineering) using FEM (Finite element method) simulations were generally used in the design field. FEM simulations were classified the static implicit and explicit dynamics method. Particularly FEM simulations using the static implicit method were very generally and usefully used in the industrial world. The static implicit method FEM consists of static, buckling, thermal, vibration analyses and so on. This FEM thermal analysis can't calculate for the phenomena of heat build-up and internal forced cooling in a machine tool. On the other hand, when the temperature distributions in a structure such as that are calculated, FVM fluid simulation was used for that. However, this simulation can't exactly calculate a complex structure in a machine tool, needs very long calculation times and the calculation accuracy is very poor. Therefore, in this research, the calculation technique regarding FEM thermal simulation using 4 virtual fluid elements was developed and evaluated for the phenomena of heat build-up and internal forced cooling in a machine tool. The algorithms and the calculation models regarding 4 virtual fluid elements were developed, then the proposed method was evaluated in the experiment. It is concluded from the results that; (1) the 4 virtual fluid elements were developed for FEM thermal simulation instead of FVM fluid simulation, (2) FEM thermal simulation with the developed 4 virtual fluid elements has high calculation accuracy and a short calculation time, (3) the proposed method was very effective in the design.

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