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微纳技术与精密机械

支持向量回归机在数控加工中心热误差建模中的应用

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摘要：　研究并选择最佳模型对数控加工中心加工过程中的主要误差源-主轴热误差进行补偿，以便提高机床的加工精度。以leaderway-V450加工中心为实验对象，对主轴热误差支持向量回归机模型和多元回归模型进行了分析对比。首先，根据夏季数据建立了多元回归模型和支持向量回归机模型。然后，将夏季另一批数据和秋季数据分别代入两种模型计算各模型补偿精度。最后，根据两种模型的精度变化规律比较两者稳健性。实验结果表明：支持向量回归机夏季模型用于补偿夏季和秋季热误差补偿标准差都小于2 μm，而多元回归模型用于补偿夏季数据补偿标准差小于2 μm，用于补偿秋季数据补偿标准差大于8 μm。数据显示支持向量回归机模型用于热误差补偿不仅具有较高精度，同时具有较好鲁棒性。

关键词：　热误差　多元回归模型　支持向量回归机　数控加工中心

Application of support vector regression machine to thermal error modelling of machine tools

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Abstract: This paper explored and selected an optimal thermal error model of the Computer Numberical Control(CNC) machining center to compensate the main error source, the thermal error of spindle, in the machine processing and to improve the machining accuracy. In experiments, the leaderway-V450 machining center was taken as a compensation object, and the Support Vector Regression (SVR)model and Multiple Regression(MLR) model were analyzed and compared. Firstly, the MLR model and the SVR model were established according to the first batch of data of the CNC center gained in summer. Then, by substituting the second batch of data measured in summer into two kinds of models respectively, the compensation accuracy of each model was calculated. Furthermore，by substituting the third batch of data measured in autumn into two kinds of models respectively，the compensation accuracy of each model was calculated again. Finally, the robustness between both models was compared according to the precision variation regulation. The experiment shows that the compensation standard deviations of SVR model both in summer and autumn are less than 2 μm, and that of MLR model in summer is less than 2 μm, while less than 8 μm in autumn. These data show that the SVR model not only has high accuracy, but also has higher robustness for the thermal error modeling of CNC center.

Keywords: thermal error　Multiple regression model　Support Vector Regression (SVR) machine　Compuater Numerical Control(CNC) maching center

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