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*X-Y*精密定位平台的敏感函数逆前馈补偿控制

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Feedforward compensation control of *X-Y* precise positioning table using inversed-sensitive function

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摘要 针对音圈电机驱动的*X-Y*定位平台中稳态误差导致的系统定位精度较低的问题，提出了基于敏感函数逆的前馈补偿控制方法。首先，采用频域辨识方法建立了系统模型，基于终值定理推导出系统扰动和稳态误差的关系，并由此设计了敏感函数的逆模型来补偿扰动对稳态误差的影响，从而提高系统精密定位性能。最后，在搭建的音圈电机驱动*X-Y*定位平台上进行了不同运动行程的实验研究。实验结果表明：在行程为10 μm，最大加速度为6 mm/s^{2}的微定位运动条件下，补偿后的定位误差可由2 μm降低到0.2 μm;在行程为10 mm，最大加速度为6 m/s^{2}的宏定位运动条件下，定位误差可由2 μm降低到0.4 μm。实验结果验证了本方法的有效性，为后续高精密伺服系统的研制提供了重要参考和设计依据。

关键词 ： 音圈电机，精密定位平台，敏感函数，前馈补偿

Abstract : As the stable state error of an *X-Y* precise positioning table driven by a Voice Coil Motor(VCM) will lead to a poor position precision, a feedforward compensation method based on inversed-sensitive function was proposed. Firstly, the system model was set up based on frequency domain identification, and the relationship between system disturbances and steady state error was established using final-value theorem. Then, an inversed-sensitive function was designed to compensate the effect of the disturbances on the stable error and to improve the positioning accuracy of the system. Finally, the experiments of different strokes were implemented on the *X-Y* table driven directly by the VCM to validate the efficacy of the proposed method. The experimental results show that the static errors of the system decrease from 2 μm to 0.2 μm with a micro positioning of 10 μm and a maximum acceleration of 6 mm/s^2, and those decrease from 2 μm to 0.4 μm with a macro positioning of 10 mm and a maximum acceleration of 6 m/s^2. Obtained achievements verify the validity of the proposed method and provide a references for the subsequent study in high accuracy positioning servo system design.

Key words : voice coil motor precise positioning table sensitivity function feedforword compensation

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