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### 光电探测系统指向误差分析、建模与修正

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### Analysis, Modeling and Correction of Pointing Errors for Electro-optical Detection Systems

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摘要

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**摘要** 针对光电探测系统(EODS)的高精度指向要求,提出一种基于半参数回归模型(SPRM)的改进算法。全面分析了误差来源,如光学系统的光轴一致性误差、机械框架的垂直度和回转误差、控制系统的稳定跟踪误差等,采用多体系统运动学理论,建立了具有明确物理意义的指向误差线性模型。同时,针对系统中的非线性误差因素,提出了半参数回归模型改进算法。数值仿真表明:改进算法能够很好地抑制测量数据中非线性误差的干扰,参数辨识精度优于0.6";转台实验表明:修正后,系统的指向精度从23.41"提高到2.00"。

**关键词:** 光电探测系统 指向误差 误差分析 多体系统建模 线性模型 半参数回归模型

**Abstract:** An improved algorithm based on a semi-parametric regression model (SPRM) is proposed in this paper to achieve high accuracy pointing for electro-optical detection systems (EODSs). The error sources are analyzed comprehensively, which are mainly composed of consistency errors of the optical system, perpendicularity and rotation errors of the mechanical assembly, stability and tracking errors of the control system, etc. And then, the multi-body kinematics theory is used to structure a linear model with parameters of definite physical meaning. Subsequently, an improved SPRM model is derived to eliminate the nonlinear errors. Numerical simulations are carried out and the results demonstrate that the nonlinear interferences can be suppressed by the proposed algorithm and the identification accuracy is superior to 0.6". Finally, an experiment based on a rotation table shows that the pointing accuracy is improved from 23.41" to 2.00" after the correction of error sources.

**Keywords:** electro-optical detection system pointing error error analysis multi-body system modeling linear model semi-parametric regression model

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