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信息科学

数字图像相关法测量金属薄板焊接的全场变形

胡浩, 梁晋, 唐正宗, 卢岗

西安交通大学 机械工程学院, 陕西 西安 710049

摘要：提出了一种基于数字图像相关法和双目视觉技术的全场三维变形测量方法来测量金属薄板焊接过程中的高温变形。首先,提出一种基于种子点的高精度图像匹配算法求解相关匹配非线性优化初值。然后,介绍了三维坐标重建以及三维位移、三维应变的求解算法。最后,借助于VC++6.0开发环境,研制了用于薄板焊接全场变形测量的实验系统。为验证本文方法在材料力学性能实验方面的可行性,利用标准材料试验机 and 自主研制的图像采集装置设计了钢试件的标准拉伸实验,并采用Q235板材料进行了焊接变形测量实验。实验表明:本文方法的应变测量精度为0.5%,与引伸计的测量结果基本相当;与传统的测量方法相比,提出的方法可以更全面、更直观地测量金属薄板在整个焊接过程中的三维位移和应变场,并且测得的3个方向的位移变化曲线过渡自然、数据合理,是研究焊接变形规律的有效手段。

关键词：双目视觉 图像相关法 种子点匹配 薄板焊接 全场变形

Measurement of full-field deformations in metal sheet welding processes by image correlation method

HU Hao, LIANG Jin, TANG Zheng-zong, LU Gang

School of Mechanical Engineering, Xi'an Jiaotong University, Xi'an 710049, China

Abstract: A new three-dimensional deformation measurement method was proposed based on digital image correlation and binocular stereovision to measure the full-field deformation in metal sheet welding processes. Firstly, an algorithm based on a seed point was proposed to provide a reliable initial value for the least-square nonlinear optimization in the correlation matching. Then, the algorithms for three-dimensional coordinate reconstruction, three-dimensional displacement and the strain calculation were discussed separately. Finally, based on these algorithms and the VC++6.0 platform, a welding deformation measurement system was developed for the full-field deformation of metal sheet welding. With self-developed image acquisition devices and a standard material testing machine, a steel standard tensile test and a welding deformation measurement test were conducted to validate the performance of proposed method. Experimental results demonstrate that the accuracy of strain measurement is not lower than 0.5%, which is very close to that of a extensometer and the measured 3-D displacement time history is reasonable. It concludes that the proposed method can satisfy the requirements of non-contact, higher precision, and it is a more intuitive way for full-field deformation measurement during metal sheet welding processes.

Keywords: binocular vision digital image correlation seed matching metal sheet welding full-field deformations

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通讯作者: 胡浩

作者简介:

作者Email:

参考文献:

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