●工艺与设备

VistaWeld焊缝自动跟踪系统在螺旋焊管生产中的应用

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摘 要: 传统的螺旋焊管焊缝自动跟踪装置精度低,灵敏度差,响应时间长,对操作人员操作技能要求高,已不能满足焊接工艺的要求。英国 Meta公司的 VistaWeld焊缝自动跟踪系统是以激光条纹为工作介质,当摄像头采集到激光条纹图像后,送入计算机进行图像处理,得出结果后由执行机构完成相应动作。该系统具有可靠性高、工作稳定、结构简单、安装维护方便等优点,从而使螺旋焊管的焊接质量有较大的提高。

关键词: 螺旋焊管; 焊缝; 自动跟踪; 激光
中图分类号: TG409 **文献标志码**: B **文章编号**: 1001-3938(2007)04-0058-03

1 系统组成

VistaWeld焊缝自动跟踪系统主要由传感器、机械执行机构、主控制柜、操作控制器和视频显示终端、手控盒等部件组成。系统结构框图见图 1。

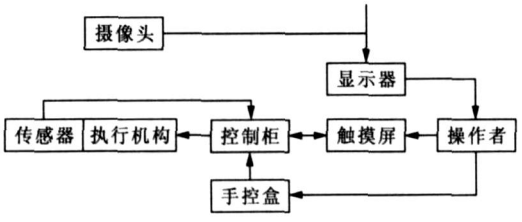

图 1 VistaWeld焊缝自动跟踪系统结构框图

1.1 传感器

传感器部件主要由激光传感器组成,是整个系统中最重要的器件。传感器内装有一个 3B激光发射器和一个高分辨率 CCD微型摄像机,该摄像机用来采集钢管焊缝表面的激光条纹。摄像机的镜头前面装有一个滤光片,只允许激光通过,其他光线(如弧光等)不能通过。

1.2 机械执行机构

机械执行机构主要包括伺服电机、电动滑架及机械连接部件。工作时电机接受电机控制器的指令,带动滑架及焊枪移动,滑架上装有限位开关,防止滑架超越极限位置。

1.3 主控制柜

主控制柜包括 PC机、PLC(可编程控制器)、伺服电机控制器、24V直流电源、系统隔离器、柜内空调、KVM扩展模块。PLC为美国 Rockwell公司生产,型号为 CompactLogixL35E。

1.4 操作控制器和视频显示终端

操作控制器是一个触摸屏显示器,允许操作者控制系统和设置参数。视频显示终端是一个高清晰彩色显示器,用以观察焊缝的实际情况。

1.5 手控盒

手控盒上包括急停按钮、激光器开关、自动/手动开关、上下/左右微调按钮和指示器、手动操作手柄。打开激光器,按下触摸屏上的“跟踪”键,当开关处于“自动”位置时,系统进入自动跟踪状态,此时手动操作手柄被禁止,只能用上下/左右按钮来微量调整焊枪偏移。当开关处于“手动”位置时,自动跟踪被禁止,操作者只能用“手动操作手柄”来调整焊枪偏移。

2 系统工作原理

传感头工作原理如图 2所示,这里只画出一条激光条纹,三条纹激光与此相同。本系统属于

采用激光作为主动光源的结构光法视觉传感焊缝跟踪系统。该结构光法不仅能检测出焊缝的中心位置,而且还能获得焊缝截面的形状和尺寸等特征参数,并且适合于不同的焊缝和各种焊接方法。

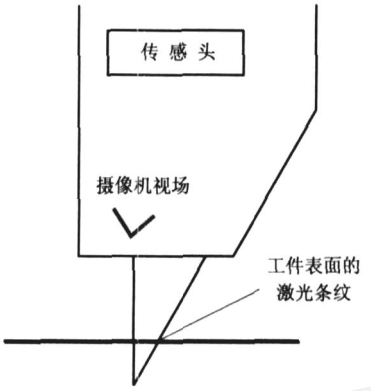

图 2　传感头工作原理

系统工作流程如图 3所示。当传感头内激光器发射的三条纹激光照射在钢管焊缝表面时,高分辨率 CCD摄像机采集到因焊缝而变形的激光条纹,通过传感头发送回主控制柜内 PC机的图像采集卡中,再经 PC机中的图像处理软件分析,并测量出焊接接头的实际位置。此时首先调整焊枪使其在焊缝的中心位置,再通过传感头上手动十字滑架来调整传感头,并观察图像直到焊缝图像在显示窗口的中心位置。如果此时设定标准参考点,则此参考点被 PC机中内部图像处理软件设定为标准位置。当手控盒上的自动/手动按钮打到"自动"档后,系统自动将采集到的激光条纹图像位置与设定的标准位置相比较,并计算出二

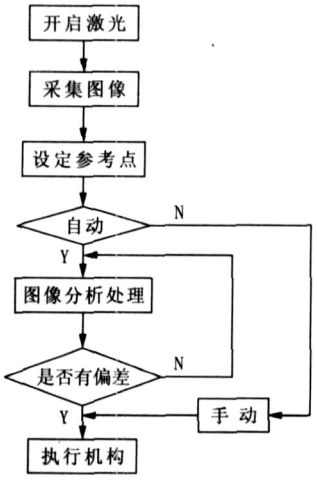

图 3　系统工作流程图

者之间的偏差,最后由 PC机决定是否发出移动和如何移动指令。如果需要移动则 PC机发出移动指令到 PLC,PLC控制电机驱动器来控制电机和滑架移动。因滑架和焊枪在同一执行机构上,滑架带动焊枪,使焊点处在焊缝的中心位置,完成一次自动跟踪。激光器每 40 ms发射一次,可实时采集激光条纹进行图像分析处理,满足了系统跟踪的要求。

3　参数设置

启焊时,运行跟踪应用软件,出现如图 4所示的初始化主窗口。

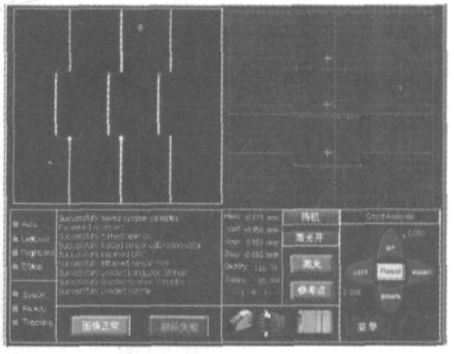

图 4　初始化主窗口界面

初始化主窗口主要包括视频图像窗口、激光条纹图像窗口、分析结果显示窗口、操作按钮和状态显示、跟踪微调按钮和菜单按钮。通过该窗口,用户可以观察到焊缝中心位置距离设定参考点的水平和垂直偏差值,及焊接接头的间隙宽度和错边量,还可看到传感头、图像卡、PLC这 3个硬件的状态及其他参数。

按下主窗口菜单按钮,进入参数设置对话框,如图 5所示。在大多情况下,系统在出厂时很多参数都已经设置好,用户对这些参数可以不作调整,但有些参数需要用户根据现场情况进行调整设置。需要调整的参数有:设置参数点、轴运动速度、校正极限、校正死区、分析灵敏度、微调步长和焊接接头形式。

(1)设置参数点　操作者根据现场情况确定焊点位置,同时保证焊缝图像位于显示窗口的中心,此时可按下参考点按钮设定图像参考点。

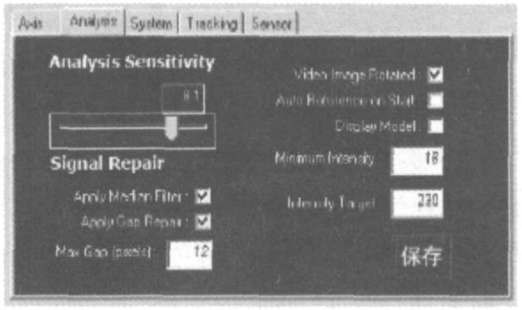

图 5　系统参数设置界面

(2)轴运动速度　该参数定义了当用手控盒上的手动手柄操作时的速度,有 2个选项,分别为起始速度和最终速度。

(3)校正极限　当系统计算出的偏差大于此值时,系统会认为是一个超差,从而拒绝向伺服电机发出移动指令,这样可防止偶然增大的偏差而使滑架移动。

(4)校正死区　设定此值时与校正极限相反,当系统计算出的偏差大于此值时,系统向伺服电机发出移动指令,即偏差在校正死区和校正极限之间时,系统才执行跟踪功能。

(5)分析灵敏度　分析灵敏度是由滑块设定。操作者可以滑动滑块使图像效果最佳,从而获得可靠的跟踪。

(6)微调步长　在自动状态下设定此值,当操作者按下微调按钮时,滑架所移动的微调距离称作微调步长。

(7)焊接接头形式　焊接接头形式即焊缝类型。应选择正确的焊接接头形式,使图像获得最佳的分析效果。如在螺旋焊管生产中,内焊缝可设置成 Step,外焊缝可设置成 But或 Vee。

4　系统维护

工作之前,要检查传感头与焊接机头是否绝缘良好,检查各操作按钮是否在初始位置或正常位置。系统启动后,要保证传感头的气冷和水冷设备工作正常,且气体要保持清洁和干燥。气体起到使传感头冷却和净化烟尘的作用,水对传感头起到再冷却的作用。

为保证得到最佳的激光条纹图像,传感头安装高度的最佳距离为 70 mm,其安装高度从传感头前部开始测量,而不是从保护片开始。在正常工作状态下,图像质量的好坏是决定跟踪成败的关键。为获得最佳的图像质量,要保证传感头的可拆卸塑料片和滤光片清洁、干净、无污染,须定期对可拆卸塑料片进行擦拭,如果擦拭后仍然较脏,则需更换新的塑料片。

特别注意的是,对传感头的任何操作都要先关闭激光器,防止激光对眼睛的损害。而且应使触摸屏显示器远离焊管磁场的影响,否则会使触摸屏显示器损坏。

传感器出厂时,内部各器件已标定,用户不得拆开传感器,否则传感器易出现故障或损坏。因此日常维护时,传感器内部没有需要用户维护的部件。当传感器上面的激光警示灯损坏时,激光器自动关闭,传感器停止工作,此时,需及时更换新的传感器。

5　结　语

VistaWeld焊缝自动跟踪系统在螺旋焊管生产现场的实际运行证明,该系统可纠正焊枪相对于焊缝出现的微小偏差,大大提高了钢管的焊接质量。与传统跟踪设备和人工操作相比,该系统具有跟踪精度高、响应速度快、操作容易、人机界面友好等优点。同时该系统还具有良好的扩展功能,能够实现软硬件的升级,以满足更高用途的要求。该焊缝自动跟踪系统现已在国内多家焊管生产企业得到了成功应用。

参考文献:

[1]伏喜斌,林三宝,杨春利. 激光技术在焊接质量控制和检测中的应用[J]. 焊接, 2006(10): 24-29.

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收稿日期: 2006-12-19

Application of Bar Code Technology by Steel Pipe Enterprise

LI Chun-lin

Abstract ID: 1001-3938(2007)04-0047-EA

Abstract: Current situation of pipe marking by China steel pipe enterprise briefly analyzed. The bar code technology has been developed in order to solve problem of pipe No. repeating and wrong pipe number in pipe manufacturing during production. Combining computer information control system of pipe manufacturer, the bar code technology is successfully applied into pipe production process and realizes automatic collection and input of pipe number and other information for whole production process, and increases working efficiency while reduces production cost.

Key words: steel pipe; bar code technology; tracing of pipe number

Manufacture of the Clayed Aluminium Alloy for Automotive Heat Exchanger

HU Rui-ling, LI Zhi-qiang, XIE Jian-ying

Abstract ID: 1001-3938(2007)04-0049-EA

Abstract: Clayed aluminium alloy, with Al-Mn as the core and covered Al-Si brazing filler metal layer outside and Al-Zn anticorrosion layer inside, is welded together using high frequency current, then is brazed by Nocolok brazing method. The radiator has excellent integration performance and wider application foreground.

Key words: automotive heat exchanger; clayed aluminium alloy; Nocolok brazing

Design and Application of Inside Welding Double Wires Welding Unit for Spiral Submerged Arc Welding Pipe

LIU Yun, PENG Chun-ming, LIU De-ying

Abstract ID: 1001-3938(2007)04-0051-EA

Abstract: In accordance with specialty of double wires welding process of inside welding for spiral submerged arc welded pipe, a set of internal welding double wires welding unit is developed. It compose of tracking unit of butter welding with filled wire, guiding mechanism of welding arm, feeding system, elevating mechanism, and conductive welding torch, etc.. It can be applied into inside welding double wires welding for steel pipe of larger wall thickness and outside-diameter in exceeding of 559 mm with solid structure, convenient adjusting, stabilization and reliability in operation.

Key words: spiral submerged arc welded pipe; double wires welding; internal welding unit

New Type Tactile Sensor of Weld Seam Tracking System

ZHU Jia-lei, JIAO Xiang-dong, JIANG Li-pei, XUE Long, ZHOU Chan-feng, YU Jian-rong

Abstract ID: 1001-3938(2007)04-0054-EA

Abstract: A tactile sensor of weld seam tracking system was introduced in this paper. The system collect the weld seam by the durative touch between the sensor and the seam, and transform the movement of the sensor into electricity signal. By using the PLC drive the electromotor of turning control and height control, achieving the adjust of the welding torch and the real time tracking. The practice prove that the system can fulfill the responsibility and can meet the need of engineering welding.

Key words: seam tracking; welding robot; tactile sensor

Pass Design of High-strength Welded Pipe

MA Hai-jun

Abstract ID: 1001-3938(2007)04-0056-EA

Abstract: High-strength welded pipe was designed out by Shanghai Shen Hua Steel Pipe Co., Ltd by breaking through traditional cold-bending forming change on OD 114 mm high frequency welded pipe units. The characteristic and its production process flow of high strength welded pipe are introduced. The pass design method of high strength welded pipe is also explained with examples. It has been proved by actual application that the metal consumption of high-strength welded pipe is lower than that of traditional rectangle tube under the same using condition. High-strength welded pipe has been widely used for many industries, such as mechanical manufacturing, automobile framework, storage shelf and light steel construction etc., with practical patent.

Key words: welded pipe; cold-bending forming; pass design; metal consumption

Application of "VistaWeld" Weld Automatic Tracking System in the Production of Spiral Submerged Arc Welded Pipe

ZONG Bo, LIU xin, YANG Wan-xia

Abstract ID: 1001-3938(2007)04-0058-EA

Abstract: Traditional weld automatic tracking system can not meet requirements of welding process due to low precision, poor sensitivity, longer response time and high skill operation requirements to operator. "VistaWeld" weld automatic tracking system made by British Meta Co. is based on laser stripes as working medium. After the image of laser stripes is collected by video camera and then it is inputted into computer for image processing, finally the executing unit will complete its related action after obtained the results. "VistaWeld" weld automatic tracking system makes welding quality of spiral submerge arc welding pipe greatly improved with advantages such as high system reliability and stability operation, simple structure, and convenient for installation and maintenance etc.

Key words: spiral submerged arc welded pipe; weld; automatic tracking; laser

Matching of Welding Process with Milling Shape of Strip Edges for Spiral Submerged Arc Welded Pipe

LIU Hong-fei

Abstract ID: 1001-3938(2007)04-0061-EA

Abstract: To adopt milling machines to prepare strip edges and groove to give good condition for forming and welding of spiral submerged arc-welded pipe. The article introduces to determine milling shape of strip edges, establish milling process of strip through calculating weld penetration as well as calculating section, width and reinforcement of weld bead by establishing strip milling process and making comparison with ideal section, width and reinforcement of weld bead to adjust welding parameters to achieve matching between milling shape and welding process and ensure welding quality of spiral submerged arc welded pipe.

Key words: spiral submerged welded pipe; milling process; groove type of strip edge; welding process; welding penetration; width of weld bead