ABSTRACT

The work in this thesis is concerned with investigations into the development of on-line monitoring and adaptive control systems for plasma arc welding and CO2MIG welding processes based on machine vision and indirect thermal sensing. The existing monitoring techniques and control strategies are reviewed in the thesis. The review brings out that computers and machine vision based control systems are attracting wide interest in the development of automated systems for welding processes.

A PC based sensor system for micro plasma arc welding is developed for on-line monitoring and adaptive control of welding current. The operation of control system is based on fluctuations in the intensities of efflux plasma emanating from a "keyhole" in the keyhole mode of operation.

The feasibility of using a CCD camera, with IR pass filter mounted onto it, as a vision sensor for monitoring the surface temperature distribution during welding is investigated. Thermal scanning around the moving arc spot, showing the deviations of isotherms from the desired pattern reveal any joint misfit, plate gap or arc shift. Processing of the thermal images obtained from plasma arc welding and CO2MIG welding for subsequent control of path guidance during butt welding is also investigated.

A methodology for the intelligent tracking of the welding torch along the seam is presented. Thermal images are obtained from the weld area and are analysed using some basic image processing routines. A control algorithm is developed that involves a technique based on weld pool image analysis using available statistical concepts. Noise that is present in the image due to spatter during welding process is eliminated and a seam line is derived from the data acquired from the thermal images. Hardware interfaced to the machine vision system, positions the work-piece under the torch in real-time as the welding is in progress.

The efflux plasma intensity monitoring technique has been found quite successful, provided the backside of the weld is accessible. Thermal sensing technique appears quite promising in as far as monitoring of various aspects of welding process is concerned.

Thus, in this work attempts are made to develop vision based monitoring and control systems for some of the most sought welding processes for monitoring the thermal gradients, controlling the welding current, tracking the seam geometry etc.

Key Words :

CCD Camera, CO_2mig Welding, Efflux Plasma, Feedback Control, Image Analysis, Infrared (IR) Pass Filter, Keyhole, Machine Vision, Micro Plasma Arc Welding, Online Monitoring, Photo Transistor, Seam Tracking, Sensors, Thermal Sensing,