Investigations Of Vision Inspection Method For Surface Defects In Image Processing Techniques- A Review

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ABSTRACT

The review has been conducted based on the machine vision system using image processing technique in the manufactured components. Also, this review used to identify ways are available to analysing geometric tolerance information in components, and failures in features of the products. In addition, this research shows how to measure the dimensional quality, structural quality, surface and operational quality in a component. Inspection of casting defects by machine vision system has been investigated in this review. This paper exposed the current process in vision inspection and important issue of design, develop and analyze the industrial vision systems.

KEYWORDS: Machine vision, automated visual inspection, image processing, image analysis.

INTRODUCTION

Nowadays society and organizations expect high quality in a product. For improving the quality in a product most of the industries implement the process monitoring in manufacturing stream. Currently, the manufacturers are using machine vision based inspection to improve their productivity and reduce costs. The vision inspection systems have become emerging technique in manufacturing systems with large batch production, high quality manufacturing and fabrication in specialized environments. Dusan et al., [3] investigated possibilities of designing automated visual inspection based on LabVIEW for searching and counting of selected parts of products. The algorithms such as pattern, geometric matching and colour difference are key elements of all analysing software. Malamas et al., suggested that machine vision system is used to identify the defects in inline inspection process, which is an inexpensive and non-destructive evaluation technique. Figure 1.1 shows that machine vision system is based on the application, environment and objectives the typical setup includes the computer capturing images from one or more cameras mounted above or around the illuminated area of interest.
2.0 Machine Vision Systems for Defect Detection:

Machine vision system is used to perform the inspection at higher speeds, flexible manner with greater precision. Yu Xie et al., [16] developed a mathematical model for defect inspection. It is namely as localized defects image model (LDIM) and it is differ from other manual inspection. The investigation comprises two specific aspects that is deviation of colour and fluctuation of colour. In this mathematical model background image region also considered. Finally the author suggest the LDIM mathematical model could be practically implemented in manufacture quantify inspection to avoid human error.

2.1 Stages of Machine vision system:

The machine vision system consists of software and hardware tools. Also, the following inspection steps are available viz., image acquisition, image processing, feature extraction and feature classification. Feature extraction is quantification of the segmented image and features are analyzed by statistical or other computing techniques like neural networks or fuzzy systems. Catalin and Dumitru, [1] research paper presents the utilization of artificial intelligence by the techniques fuzzy logic for analysis of X-ray images of industrial parts for defect detection. The radiographic images were collected from the inspected product, and the two stages algorithm is presented based on the feature analysis. The images are analyzed by using fuzzy logic techniques, whether the current object can be identified as a defect from the geometrical point of view and the final decision by using logical criteria that is dependent on the product at hand and its quality requirements.

2.2 Machine Vision system elements:

The machine vision system elements are front-end optics, frame grabber, processor and software. A frame grabber is a processor that accepts the video input from the camera, digitizes it, and stores it for analysis. The frame grabbers incorporate special processing electronics that speed the image processing and feature extraction tasks. Kun et al., [5] investigated an actual S-scan detection image was obtained from a real time ultrasonic acquisition system. The ultrasonic phased array non destructive testing, the amplitude of the grain noise can be smaller than that of the echoes, and it can totally mask echoes characterizing faults. The algorithms such as band pass filter, low pass filter, wiener deconvolution and wavelet employed to reduce the grain noise. The comparison was made on the results show that the wavelet de-noising algorithm is better than band pass filter, low pass filter, wiener deconvolution algorithms. This approach is used to reduce the amplitude of grain noise from 100% to 20%.

3.0 Vision Inspection of the Manufacturing Components:

The machine vision system requires unique illumination and heuristic approaches to image processing and analysis. This method provides low cost reliable solutions to quality control problems of metrology and defect identification. The machine vision system is used to identify and classify the defects of dimensional quality, assembling (structural quality), surface quality and accurate operation.
3.1 Dimensional quality:
Dimensional quality is measured the dimensions of an object within specific tolerance and identify the dimensional parameters. Muhammad et al., [7] investigated to develop an on-line inspection of roundness error using machine vision. The roundness can be inspected by roundness measuring machine and coordinate measuring machines. The author developed a machine vision system it consists of camera, job holding devices, lighting device and image processing software for roundness evaluation. The automotive camshaft is taken as a sample of the cylindrical part to identify the roundness error.

Quandong and Xin, [8] presents an automatic visual inspection system for circular objects. The theme of the paper is pattern analysis of circular objects based on image analysis and proposes a computational method using global symmetry to locate objects. It aims at designing a symmetry measure based on distance weight, phase weight and intensity weight. It can be used to locate centres of circles, even with weak contrast under uncertain complex backgrounds. Then based on the measure, similarities of arbitrary circular components are tested and the experimental results are validated.

Mohammed and Safaa, [6] presents a novel visual inspection approach that can be used on-line to test simultaneously multiple quality characteristics. The image processing tools to deal with the product image and extract features of its geometrical characteristics. The index is experimentally developed for each characteristics based on tolerance bands and to reflect the deviation of a quality characteristic dimension from its nominal value and decide whether a characteristic complies with the pre-specified tolerance. The Statistical analysis is proved that strong association between the developed indices and deviations of quality features from their specified values. Linear regression models are proved to model these associations and are used to give the related indices values related to the tolerance specifications. This approach is proved for non-conforming products and specified the defect locations.

3.2 Structural quality:
The structural quality examined the missing components of screws, threads and assembled parts or presence of foreign objects. Yutao et al., [16] investigated the fast processing of foreign fibre automated inspection and image analysis of foreign fibre. This paper deals the colour images were captured and transformed into gray-scale images and whole image was divided into several blocks. The several blocks are identified the target foreign fibre image through image pre-decision and otsu algorithms which possibly contains target images after background eradication and image strengthening. The paper result shows that this method of segmentation of accuracy and speed over the other segmentation methods. It connects the target image fractures location and getting an intact of clear target image foreign fibre.

3.3 Surface quality:
Surface quality inspection is finding the surface scratches, cracks, wear and roughness of the manufactured components. Dieter et al., [2] investigated a fast evaluation of the injection moulded parts on sink marks in surfaces. The research work on the detection of surface defects, and new model for the calculation of the visibility of sink marks from charge coupled device (CCD) images. A new surface model function determined the amplitudes of the second derivatives (ASD) evaluate for the visual perceptibility of sink marks. It is suited to application in a machine vision system used for in-line inspection. The model parameter in injection moulding parts were produced using predefined processing conditions and the influence of process parameter deviation on the visual perceptibility of the sink marks was evaluated and tested. This type of defect arise as a consequence of the shrinkage of the polymer material in the cooling phase after injection. Sink marks are reduced by applying high holding pressures after the injection.

Srivani and Anthony, [13] expressed the computer vision system is measure the surface quality and characterization of surface. The computerized optical microscope was used to collect the images and the images were analyzed by using MATLAB software. This paper deals the cracks in surface inspection of vision system computerized and free from human errors.

Weyrich et al., [14] investigated the new methodology to provide a fast inspection of defective objects and generate a real time motion trajectory. It processed the objects being conveyed to a high speed in an industrial large-scale production. The images of the data collected by a multispectral imaging system and are analyzed within image processing algorithms using support vector machine. The data provide path planning algorithm which considering the location, orientation and arrangement of defects peel and decay in the objects.

3.4 Operational Quality:
The operational quality is related to confirm an accurate operation of the inspected components based on the manufacturing standards. Senthilkumar et al., [9] presented the new vision inspection system to identify defects in butt joint of metal EN25817 in metal inert gas welding. This method is captured the image using CCD camera. The image captured four frames of sequence in the front light illumination method using four zones of LEDs. The images are segmented and the average grey levels of features are calculated and the same process
can be done for other four zones of welded images. The welded joints classified into the four predefined ones based on back-propagation neural network. The new approach of machine vision has an overall accuracy of 95% from the 80 samples evaluated.

Senthilkumar et al., [10] was evaluate the imperfections of gas metal arc welding by machine vision system and processed using neural networks. The imperfections assumed by Gaussian distribution method approximately by the image surfaces. The welded joints classified as a good weld, excess weld, insufficient weld and no weld by using an artificial neural network (ANN) with back propagation and ANN with differential evolutionary algorithm (DEA) individually. The results ANN using DEA is less computational time and closer to test results in the samples were compared.

4.0 Casting defects:

Zheng et al., Invistigated the automatic inspection of metallic surfaces using machine vision system. The experimental setup was created to take images of external metallic surfaces. An intelligent approach based on morphology and genetic algorithms are proposed to detect structural defects of holes and cracks on aluminium metallic surfaces. The detailed procedures include encoding scheme, genetic operation and evaluation function. The proposed method has been implemented and tested on a number of metallic surfaces and the results were discussed.

Tsai and Huang et al., discussed the automatic inspection of defects in textured surfaces which arise in sandpaper, carpet, leather, wool, tile, cork and castings materials. The proposed methods based on a global image reconstruction scheme using the Fourier transform method and it doesn’t rely on the pixel by pixel basis. This method is selecting a circle of radius r-max with origin at the centre of the Fourier spectrum image. The process can be remove the repetitive patterns using inverse Fourier transform. The restored image of homogeneous region approximately uniform gray level, and yet the defective region will be distinctly preserved. This converts defect detection in textured images into a simple thresholding problem in non textured images. The experimental results shows that the defects in statistical textures that contain homogeneous patterns in textured image and it is not classified the defect types.

Surface porosity is one of the common problems in castings that contain volume porosity in the immediate subsurface. Menzies and Koshy, discussed a novel non-contact technique of pneumatic sensor for the detection of surface porosity in intermediate and macro-level. The system has a selective inspection of surfaces including internal ones such as bore holes. It is also suited for in process inspection in the industry fitted with the direct integration into a cutting tool holder and air jet cleans the surface of machining debris. The performance is based in terms of supply pressure, stand- off distance, porosity size and speed of the inspected surface.

Swillo and perzyk, [11] investigated machine vision system image processing algorithm based on modified Laplacian of Gaussian edge detection method to identify the defects with different sizes and shapes. The defect inspection algorithm consists of defects sensitivity, threshold level and to identify the detected defects size and shape. The machine vision system identifies the defects of blowholes, shrinkage porosity, and shrinkage cavity in castings surfaces.

Swillo and perzyk, [12] examined vision based approach and neural network techniques to identify surface defects in machined aluminium die castings. The developed vision system based on modified laplacian of Gaussian edge detection method and advanced lighting system.

5.0 Conclusion and Future Work:

The review is exposed that research on vision inspection system of manufactured components. The defect analysis of ANN using DEA was less computational time and closer to real test results than ANN with BP. The wavelet de-noising algorithm is better than band pass filter, low pass filter, wiener deconvolution been employed to reduce the grain noise. Computerized optical microscope was used to collect the images and analyzed by using MATLAB software to identify the crack formed in multiple components. From this review paper we conclude 1.finding the hole and crack the genetic algorithm method was effective and gave best results. 2. Laplacian of Gaussian edge detection method using neural network technique was giving high accuracy to find the blowholes, shrinkage porosity and shrinkage cavity in effectively. Future research work on surface inspection will be planned to concentrate on the improvement of inspection methods with greater accuracy, efficiency, sturdiness and cost reduction of the squeeze casting components. Investigating the multiple defects in casting by single machine vision technique will be developed and followed in upcoming casting products. New algorithm to be developed in future research work.

REFERENCES

10. Senthil Kumar, G., U. Natarajan, T. Veerarajan and S.S. Ananthan, 2014. A vision inspection system for welded joints using a Gaussian distribution-based feature for image extraction has been developed as well as verified with real-time practices, welding journal, pp: 93.