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Test Similarity Data Ground Truth with Image Acquisition Using the Dice Algorithm

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Abstract:

In-vehicle tires there are essential components, one of it is a wire that supports the tire, there are several types of tire wire, one of it is brass plated tire steel cord. The object of brass plated steel cord tire has a micro-size below 1mm and a wave shape. In checking the quality of brass plated steel cord tire is usually measured manually by experienced experts, the manual measurement process sometimes experiences inaccuracies due to visual fatigue factors. Moreover, measurements must be repeated for the future so that it takes longer. The development of application technology using image processing is increasingly widespread, but the use of quality detection in steel cord and brass cord using image processing is are currently not found. The first step before taking an image measurement on brass plated tire steel cord is to test the similarity of the acquisition image with the data ground truth image on the brass plated steel cord tire so that it can be ascertained that the measurement stage can be done. The method used is related to the similarity test of this image using the similarity Dice algorithm. The results of the similarity test use Dice on 30 samples by comparing the data of Image Acquisition and Data Ground Truth. The truth brass plated tire cord has an average value of 99%. It can be concluded that the object edge detection of the image of brass plated tire steel cord has high accuracy for measuring using image processing techniques.

Keywords: *Brass plated tire steel cord, Image acquisition, Data Ground Truth, Dice similarity, Digital image processing.*

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I. INTRODUCTION

Process raw materials for brass-plated steel tire straps, which is one of the essential tire components. Tire wire is usually checked manually by experienced staff. In its development, tire wire experienced innovation and had various forms. At present, researchers are examining wave-shaped tire wire, and the waveform is deliberately made to form a pattern as the basis of the next process for winding wire. This corrugated wire form makes it difficult for inspection staff to detect the quality of brass platted steel tire straps in terms of thickness, amplitude, and wavelength of brass platted steel tire straps. These variations and shapes are significant and challenging in checking the quality of brass-coated steel tire straps.

Various researchers have investigated the application of digital image processing techniques to a series of evaluations and identifications. The use of these techniques to multiple fields has enabled us to be able to assess, infer, and obtain information. Before researching measuring the quality of brass plated steel tire cord using digital images, first, the sample or wire set data was tested by comparing image acquisition with ground truth data using the dice similarity method which aims to ensure that the wire object is suitable for measurement. To be more specific, this study experimented by taking a sample of brass plated steel tire cord using digital camera microscope.

II. LITERATURE REVIEW

A. Brass Plated Tire Steel Cord

Brass-coated steel cord is a composite of several individual cables. At the factory, each wire has been coated with brass and pulled to the specified diameter. The fence has been brought to a diameter of 1.22 mm and plated brass to coverage of 6.8 g brass wire/kg. After platting, this wire has not been pulled further. The thickness of the cable from the brass layer made on the diameter is the ideal specimen for engineering development [1].

Steel cords are twisted a few to dozens of ϕ0.15 ～ ϕ 0.4mm wires, and these are applied brass plating for adhering rubber [1]. Our steel cords use high cleanliness high carbon steel wire rod only for steel cords. They have enabled high strength, high flexibility, and high fatigue resistance products. Steel cords are the necessary reinforcement used for belt section that responsible for steering stability and durability in steel radial tires and also used for carcass section in large tires for trucks and busses. They are used for reinforcement for belt-shaped rubber products [1].

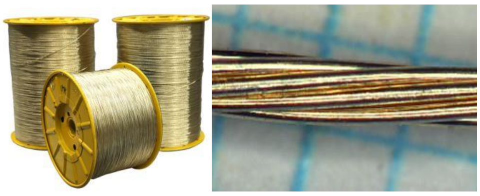

Fig. 1 Roll tire wire and braided wire [1].

Fig. 2 Brass plated tire steel cord

B. Measurement in Conventional Brass Plated Tire Steel Cord

Now to check the wire quality of the brass plated tire steel core, several measuring devices are used, namely the sliding and profile projectors. Caliper is a length measuring instrument that can be used to measure the length of an object with accuracy up to 0.1 mm [2].

Calipers are also used to measure the maximum body length of 20 cm. The advantage of using Calipers is that it can be used to measure the diameter of a marble, the width of a tube or ring, or into a machine. But Calipers still has disadvantages, such as not being able to measure large objects, expansion can occur on the device and because the sensor is in direct contact with the workpiece allows scratches or collisions that can cause evenness in both sensors and both jaws [2].

While the profile projector is used as a measuring instrument to determine the amplitude or wave height and brass-plated steel core. The profile projectors can be used for measuring rectangular coordinates (with counters X, Y) and measuring dimensions using a scale. Next, it also can be used for cross-travel stages to make dimensional measurements. Align the datum point of the workpiece with the cross line of the hair and read the Micrometer Head or the default counter. Then, the cross-travel stage chan be moved to straighten the position to be measured to the same cross-hair line and read. The difference between the two readings is the dimensions of the workpiece (or the distance between two points). Moreover the scale can be placed on the screen and measure the enlarged image. Lastly the measurement can be devided with the magnification of the projection lens to determine the actual dimensions [3].

C. Digital Image

An image that can be processed with digital computer devices must be represented numerically with discrete values first. The process of image representation from a continuous function into ethical two-dimensional distinct values is called the image digitization process [4].

Images can be defined as two-dimensional functions f (x, y), where x and y are spatial coordinates (roar) or pixel positions in the Cartesian coordinates and amplitude of function f in pairs of coordinates (x, y). The two-dimensional continuous image f (x, y) is divided into N rows and M columns. The value given in integer coordinates (x. y) with {x = 0.1, 2 ..., M-1} and {y = 0.1, 2 ... N-1} is the value of f (m, n). The components of f (x, y) indicate the intensity or value of the gray degree of image (depth) (z), color (λ), and time (t) at the point of the coordinates. If the components of x, y, and amplitudes f are discrete and limited numbers, the image is a digital image. The image amplitude value (gray level) is always an integer [5].

D. Image Quality Improvement

In the image processing process before measurement or classification, the first image of the used sample is a sharpening process, where this process is the primary step so that the measurement process or classification of image objects can be more accurate. Image sharpening can also be interpreted as a procedure for making raw images into images that are easier to understand for some applications [6].

In sharpening or improving image quality, there are several techniques used, namely, image enhancement, in the form of the image repair process by increasing image quality both in contrast and brightness. image restoration, the process of improving image models, color image processing [7]. Image enhancement techniques are used to improve the quality of a digital image, both in the purpose of highlighting a particular feature in the image as well as to enhance the aspect of the display [8]. The enhancement algorithm is used to control image contrast, which requires transformation using certain constants. [9].

E. Dice *Similarity*

Dice similarity is a method for measuring the similarity between two sets, X and Y. Here is the formula for similarity:

$$D(X,Y) = \frac{2|X \cap Y|}{|X| + |Y|} \quad \text{.............................. 1}$$

Where is | X | shows the cardinality of set X. D (X, Y) ∈ [0, 1], with D (X, Y) = 0 if and only if the set is separate and D (X, Y) = 1 if and only if the set is identical. Dice has been adapted to image segmentation and is a popular method for comparing binary segmentation from the same camera as others. Normally, comparisons are made between ground truth segmentation and the results of automatic or semi-automatic segmentation

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methods. To measure the Dice between two segments, a set must be built for each. To start, one area in each segment is specified as the foreground (as opposed to the background). If Ω is the set of all pixels in the image, the set compared to Dice is sample acquisition (SA) 1, sample grund truth (SGT) 1 ⊆Ω, where SA 1 is the set of pixels set to the foreground by the automatic method and SGT 1 is the set of pixels set to the foreground on the ground truth. D (SA 1, SGT 1) provides a measure of how accurately the automatic segmentation is generated, with more than one value to show a higher level of accuracy. As a simple example with 4 pixels, {x1, •••, x4}, if SA / 1 = {x1, x2, x3} and SGT 1 = {x1, x3}, then dice similarity coefficient (DSC) between automatic and ground truth segmentation is found using (1): D (SA 1, SGT 1) = 2 • 2 3 + 2 = 4 5. The definition of SA 1 and SGT 1 depends on which region is specified as the foreground [10].

The foreground is often chosen as the region with the highest interest, but this choice is not clear for all images and may depend on tasks that require segmentation. Terefore, when the choice of foreground region is not clear, the DSC suffers from ambiguity because the value is different depending on this choice. Although it is usually not a problem for binary segmentation, when an image is segmented into several regions, which areas will be defined as the background becomes less clear, so we want to overcome this problem when expanding DSC to compare multi-region segmentation for Cosine Similarity [10].

Based on the research that has been done by [11], several experiments were conducted to find out the results of the similarity of a document obtained from Web using Genetic Algorithms from the results of a comparison comparing several testing methods, Dice and Jaccard, where the best results were found in the Dice method then Jaccard.

F. Image Acquisition dan Data Ground Truth

Shooting is taking objects from a camera microscope to produce digital data that is done after setting up a computer vision device that creates RGB images with a resolution of 640 x 480, taking these images in experimental settings to overcome the objections [12]. Fast digital image acquisition devices and high resolution and fast processing power make the personal computer market recently revolutionized the connector standard. The interface speed to peripheral devices is used to sequence the magnitude lower than the connection speed between the motherboard and the internal method [12]. This is mainly due to parallel connector structures (64 bits or more) for internal boards and serial links to external devices [13].

Data Ground Truth is data that is created manually by following the ends of objects that can be done manually with an editor software tool [12], In general, the size of the training set or ground truth data is key to its accuracy [336–338] and the more astronomical, the better, assuming the correct information is used . Ground Truth is a parameter taken with a fundamental truth [14], The ground truth means that baseline measurement known to be very high is more precise than measurements derived from the system being tested. Truth images are images that have been labeled by an expert beforehand so that they can be used to test and compare the performance of the proposed model [15]. Fig. 3 shows an example of a Ground Truth and Color Threshold data:

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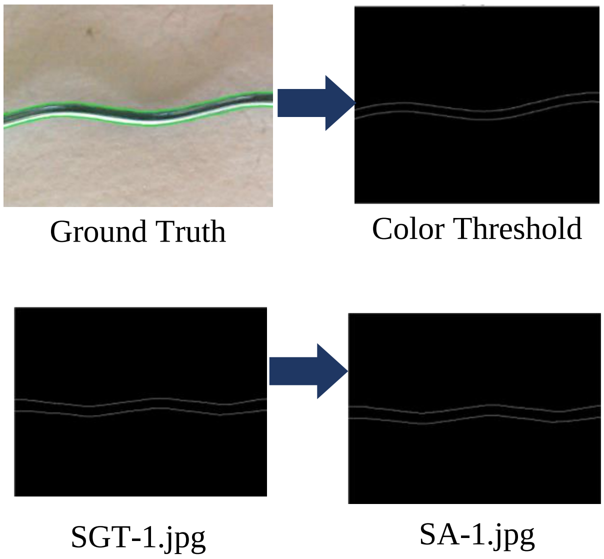

Fig. 3 Shows an example of comparing the results of image acquisition and Ground Truth data

III. RESEARCH METHODOLOGY

To find out the results of the comparison of image acquisition that has been done by edge detection and ground truth data, it is necessary to test the similarity; this result dramatically determines the quality of the extracted image of brass plated tire steel cord for the next measurement process. Fig. 4 is a method for achieving the agreement level of two objects:

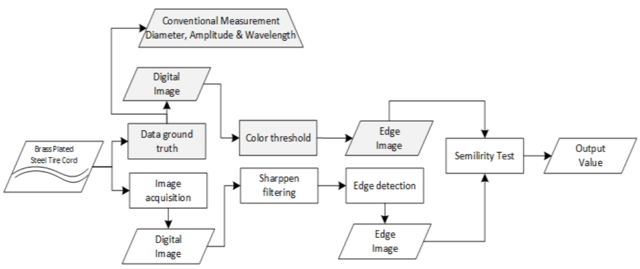

Fig. 4 Overview of research proposed method

Before the image similarity test stage is carried out, the first digital image processing is carried out with the image sharpening method and detection on tire wire. The purpose of this process is to get accurate results when measuring the similarity of a tire wire object. Fig. 5 is a flow diagram of the process stages of the similarity test:

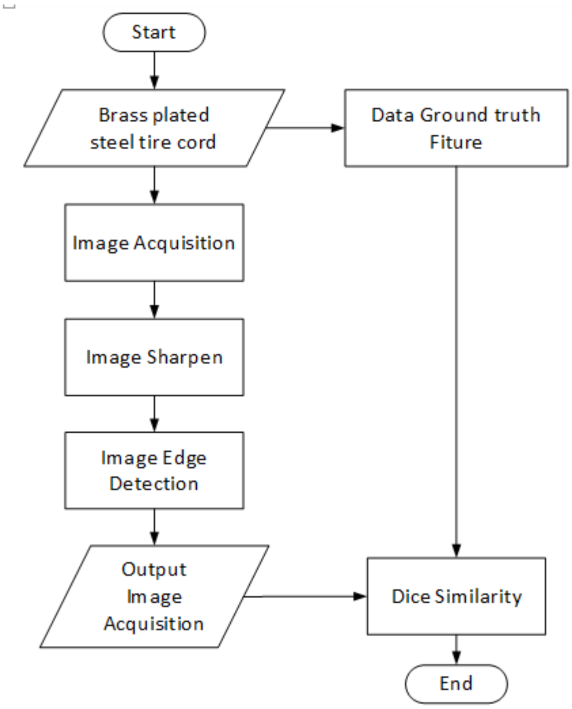

Fig. 5 Similarity Test Process

In the diagram above, the object of brass-plated steel tire straps in the process uses two techniques, namely the shooting feature and the ground truth feature. In image acquisition techniques, the first image sharpening is carried out with the aim of improving the image quality of the brass-coated steel tire straps, the second image edge detection is done with the objective to form the edge as a reference for measurement accuracy, the third output image acquisition is the result of a series of image acquisition processes .

While the ground truth data feature is the process of marking the edges of conventional brass-coated steel tire straps carried out by experts using Adobe Photoshop software. After the two data are obtained, the next process is to check the similarity of the data using the similarity dice technique, which aims to determine the suitability of conventional object measurements with image processing.

IV. RESULTS AND DISCUSSION

A. Data Sets

The tire wire similarity test process is carried out using 30 sample images of brass-coated steel

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tire images taken from each of the different machines. Fig. 6 shows the results of sampling using a digital microscope:

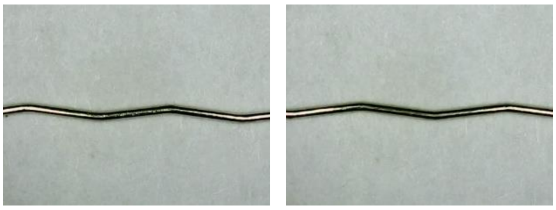

Fig. 6 Photo camera microscope digital

B. Experimental Setup

The equipment used to process the tire wire consists of several components, the first is a digital microscope camera that serves to capture images of tire wire with a diameter of 0.24mm, a tiny size that requires a zoom resolution of 50 times with lighting using a LED that has brightness quality is quite bright. The second component is the base for laying the wire that has been given measurements for calibration using cardboard. The third computer that has been installed driver software from digital camera microscope to store from the results of digital capture camera microscope, then digital image processing is performed using the Matlab 2017a software for image sharpening and eliminating edge detection. Fig. 7 is an image setup tool designed for the image capture process:

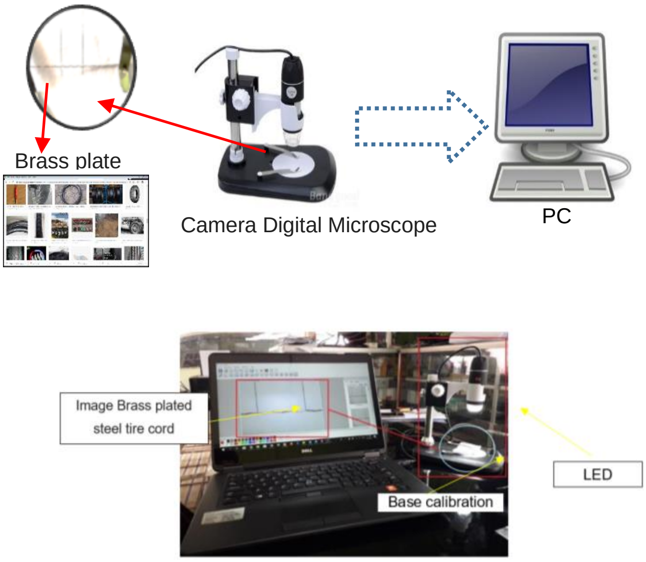

Fig. 7 Set up image processing and measure device image of band wire.

C. Similarity Dice Test Software

Software used in conducting similarity testing using DSC Calculator software. Here is a picture of the DSC Calculator software:

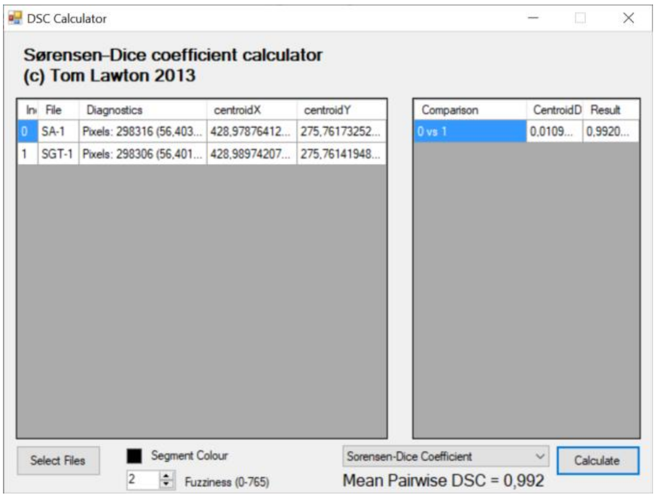

Fig. 8 Software DSC Calculator

D. Similarity Dice Test Results

After a series of phases/stages of testing on a sample of brass-coated tire cables with a total of 30 data sets, each technique both ground truth and image acquisition so that the total number of sample data is 60 there is an average similarity value produced 0.9923 or 99%. The following table. I am the result of the similarity test using the Dice similarity method:

TABLE I. SIMILARITY DICE TEST RESULTS

No	Ground Truth	Image acquisition	Ground Truth		Image Acquisition		Result
			Centroid X (px)	Centroid Y (px)	Centroid X (px)	Centroid Y (px)	
1	SGT-1.jpg	SA-1.jpg	428,990	275,761	428,979	275,762	0,992
2	SGT-2.jpg	SA-2.jpg	429,033	276,622	428,920	276,605	0,991
3	SGT-3.jpg	SA-3.jpg	428,948	275,761	428,888	275,752	0,991
4	SGT-4.jpg	SA-4.jpg	428,936	275,957	428,960	275,954	0,999
5	SGT-5.jpg	SA-5.jpg	429,086	275,595	429,037	275,601	0,993
6	SGT-6.jpg	SA-6.jpg	428,426	276,228	428,382	276,231	0,993
7	SGT-7.jpg	SA-7.jpg	428,954	275,714	429,017	275,729	0,993
8	SGT-8.jpg	SA-8.jpg	429,125	275,654	428,968	275,632	0,992
9	SGT-9.jpg	SA-9.jpg	429,053	275,354	428,900	275,338	0,993
10	SGT-10.jpg	SA-10.jpg	429,008	275,622	428,981	275,619	0,990
11	SGT-11.jpg	SA-11.jpg	429,031	275,484	428,893	275,462	0,990
12	SGT-12.jpg	SA-12.jpg	428,458	276,665	428,468	276,673	0,992
13	SGT-13.jpg	SA-13.jpg	428,438	276,695	428,495	276,698	0,992
14	SGT-14.jpg	SA-14.jpg	428,599	276,894	428,622	276,910	0,993
15	SGT-15.jpg	SA-15.jpg	428,543	276,267	428,492	276,260	0,992
16	SGT-16.jpg	SA-16.jpg	428,620	275,984	428,609	275,959	0,994
17	SGT-17.jpg	SA-17.jpg	428,458	275,675	428,471	275,690	0,993
18	SGT-18.jpg	SA-18.jpg	428,395	275,849	428,389	275,874	0,992
19	SGT-19.jpg	SA-19.jpg	428,572	276,071	428,467	276,049	0,993
20	SGT-20.jpg	SA-20.jpg	428,497	276,277	428,489	276,267	0,991
21	SGT-21.jpg	SA-21.jpg	428,604	276,167	428,519	276,145	0,992
22	SGT-22.jpg	SA-22.jpg	428,414	276,052	428,451	276,059	0,992
23	SGT-23.jpg	SA-23.jpg	428,493	276,475	428,477	276,469	0,991
24	SGT-24.jpg	SA-24.jpg	428,648	276,156	428,613	276,155	0,992
25	SGT-25.jpg	SA-25.jpg	428,532	276,351	428,548	276,095	0,992
26	SGT-26.jpg	SA-26.jpg	428,403	276,174	428,418	276,179	0,993
27	SGT-27.jpg	SA-27.jpg	428,577	275,433	428,650	275,421	0,993
28	SGT-28.jpg	SA-28.jpg	428,581	276,626	428,529	276,363	0,992
29	SGT-29.jpg	SA-29.jpg	428,620	276,420	428,595	276,415	0,992
30	SGT-30.jpg	SA-30.jpg	428,545	276,079	428,496	276,077	0,992
						Average Value	**0,993**
						Percentage	**99%**

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Figure 9 shows a graph from the similarity dice test results table:

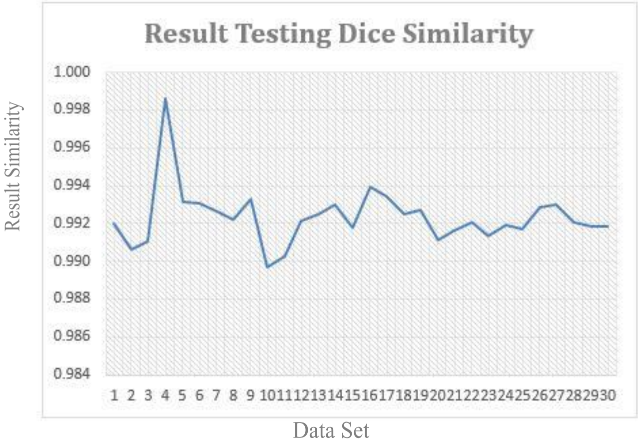

Fig. 9 Result Testing Dice Similarity

V. CONCLUSION

Similarity test results using Dice similarity in 60 samples of 30 each then cold the image acquisition data and ground truth data Brass-plated tire straps have an average similarity value of 0.9923 or 99%. It can be concluded that the edge detection of objects in the brass steel belt image has a high degree of accuracy for the development of measurement techniques using image processing:

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