METHODS OF PROCESSING POINT CLOUD TO ACHIEVE IMPROVEMENT DATA POSSIBILITIES

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Summary: This article discusses the possibility of processing point cloud data for further processing in other systems for instance inspection, measuring systems and etc. The main focus of this papers is to supplement physical possibilities scanning device. Appropriate processing method for improvement is able to fundamentally improve quality obtained data and secondary save financial expenses for hardware used in the system. In general, every method is appropriate for achiever better result in the specific aspect.

Keywords: profilometer, point cloud, processing, regression

1. Introduction

Every inspection or measuring system is based on two main attributes that obtain data and its processing. The first case obtain is based on choosing an appropriate device, which is able to offer data in sufficient quality for further processing and its post-processing in a specific system. In the beginning design of inspection systems is necessary to define the main aim and suggest appropriate hardware to achieve data. In the case of camera systems are the main advantages of multi-data collection like geometric or visual data in the grayscale or color image. The main disadvantage is in liming resolution based on camera resolution. The high-resolution camera is able to offer sufficient resolution but on other hand puts high demands on computational hardware. Laser line scanning based on profilometer scanning geometric characteristics with an appropriate resolution for instance use in an inspection system.

2. Object and system requirements

Choosing of object was establish based on main focus of works authors this papers. The main aim is developing system to detect defection on the tire. Database of detection was defined according to experiences from Tire manufacture. Some defects are shown in Figure 1. Types of defects is possible to categorize to the two main areas and its:

- Geometric defects (Impurities, mechanical integrity damage, large cracks)
- Visual defects (cracks, impurities in surfaces)

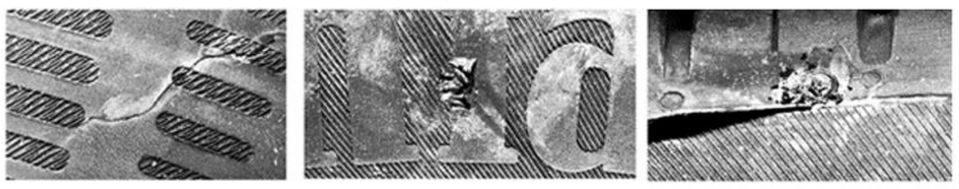


Figure 1 Examples of defects (first - crack, middle, last - mechanical integrity damage)

Geometric defects were chosen like primary focus. It’s possible to capture these defects via a camera system or a laser scanning system. In the case of camera systems is necessary to establish appropriate lighting systems, which is able to highlight edges in capturing images. In specific cases, lighting is not able to highlight edges and in final, this defect merges in the captured image illustrated in Figure 2. In this case is also significantly impact of resolutions camera system, which is able to offer possibilities to detect very small defects but on the other hand, it places high demands on computing performance.

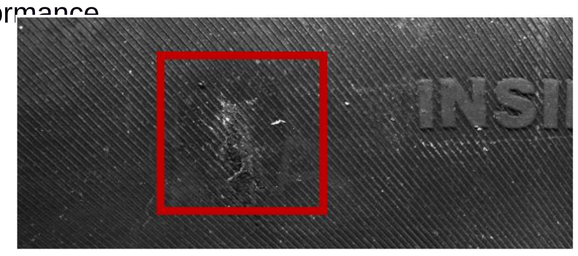


Figure 2 Defect - mechanical integrity damaged

Inspection system using a laser scanner is able to scan captured types of defects. The sufficiently working system is working with the condition, that size of defects is any multi play bigger than is resolution of scanning device. According to his condition is possible to define the premise, that it has to be chosen device with has multiply higher resolution or detecting defects are multiplied bigger than the resolution of the used device. Scanning of the sidewall of the tire was performed by scanCONTROL 2600-50.

3. Captured basic data

In Figure 3 is showed the place of the defect (impurity). There are white places, which meant missing points from point cloud. It is crucial to realize the size of the gap according to the whole size. The simplest approach is possible by filling the base on polynomial regression or mean matrix. Every method is suitable for an individual case. Polynomial regression is suitable for filling bigger gaps like 3 missing points. Equation for average standard distance between nearest points (D):

$$D = \frac{X_{gmax} - X_{gmin}}{639}$$

Where:

X_{gmax} - global maximum X value from point cloud

X_{gmin} - global minimum X value from point cloud

639 – number of points in one line without one place

For more like 9 missing points in the area (matrix 3 x 3) is appropriate polynomial regression in line, which is able to replace a higher number of missing values include border points. Mean matrix method is appropriate for adding one missing point in matrix 3 x 3.

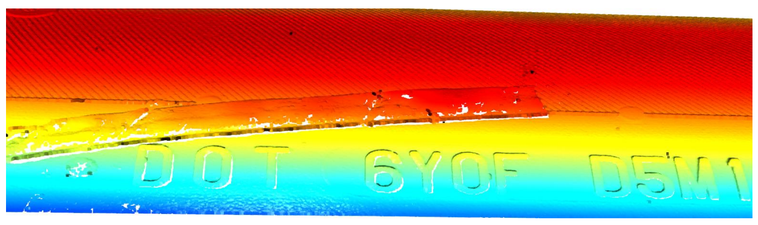


Figure 3 Basic point cloud

4. Supplement point cloud based on polynomial regression

For the better result is appropriate to use more complex polynomial regression. With a higher degree of a polynomial is possible more accurate mathematically define the real surface. Z values are computed based on X values. First, it is necessary to compute missing X values. Finally, the creation of fully generate surface is illustrated in Figure 4, which supplement basic point cloud. In mentioned figure, there is possible to recognize indication of letters but no evidently. Supplemented basic point cloud displayed in Figure 5 contain remained big gaps displayed like white place in surface.

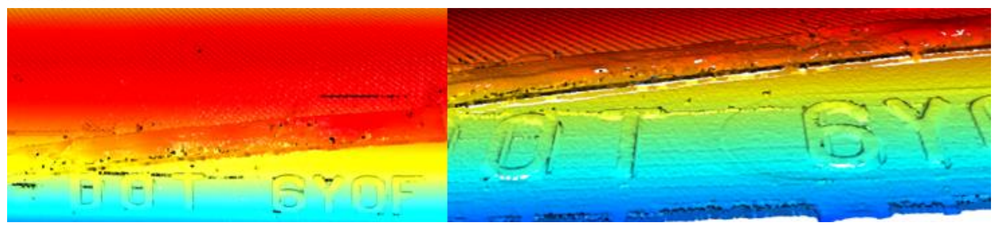


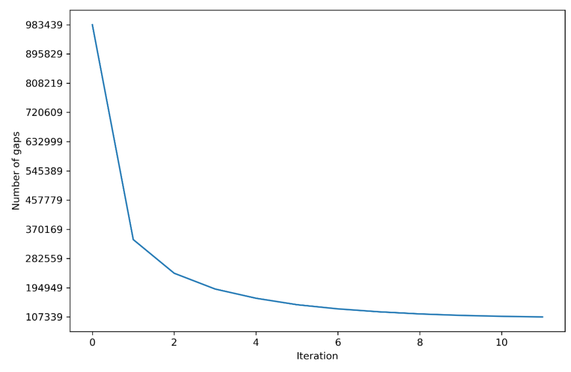
Figure 5 Supplemented basic point cloud

5. Supplement point cloud based on Mean method

This method is different from the above-described method in size of modifying or supplement points in the cloud. This way is not compatible with high supplementing for instance in the case of missing matrix 3 x 3 and bigger. This method is suitable only in supplemented borders of gaps. It is for a reasoning computing mean value from specific number points. Mean algorithm Zm values was set up:

$$Z_m = \begin{cases} \frac{\sum_{i-2,j-2}^{i+2,j+2} A_{i,j} > 0}{num\left(A_{i,j} > 0\right)} & \text{if}\left(\left(\frac{f_{max}(Z)}{5}\right) < \left(\frac{\sum_{i-2,j-2}^{i+2,j+2} A_{i,j}}{25}\right)\right) \end{cases}$$

In many iterations number of gaps is converging to a specific value, which characterizes a number of gaps in borders point cloud. It is illustrated in Figure 6 Number of gaps in iterations. In first iterations is a significant fall of gaps. And from 6th iteration gaps number converge to specific value.



6. Conclusion

In this paper, we were focused on the comparison between 2D and 3D scanning devices according to aim for further using data to another system for example in the inspection system. Other area deals with explaining importance processing DATA to improve physical characteristics scanning device, its advantages and disadvantages. In final data processing it should be appropriate in a superior system, which is able to effective working.

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