

Analysis of Overlapped Tire Marks Characteristics With The Aid of Enlarged Photography

Bhoopesh Kumar Sharma, Dinesh Chand, Raessa Bashir, Eiman Shafiq

Abstract: *Tire marks are usually encountered in hit and run cases and other accidents. Sometimes, it becomes difficult to the investigating officer to segregate the overlapped tire marks and using them as a tool to identify the vehicle used with high accuracy. Visible tire marks are important evidence during the reconstruction of crime, as they allow conclusions in regards to the speed and type of the vehicle used. In present work an approach has been made to use high resolution photographs to differentiate and segregate the overlapped tire marks on the basis of class and individual characteristics. It was observed that careful examination of high-resolution photographs will be an appropriate tool to examine and identify the tire marks and their linkage to the suspected vehicles with high accuracy.*

Keywords: *Tire marks, overlapping, high-resolution image, Reconstruction*

I. INTRODUCTION

With the increased number of vehicles on the roads, it is quite obvious for the traffic system to encounter accident cases involving vehicles. Many times, they are merely accidents, however, there are large number of hit and run cases or acts of malicious intents being reported every day throughout the world. Traffic accident reconstruction mainly depends upon the forensic examination of collided vehicles, physical evidences on encountered at the scene as well as proper evaluation of the tire and skid marks. In instances, visible tire marks of the vehicles provide valuable information about the type and make of the vehicle and speed of the vehicle [1-3]. Therefore, the tire-marks identification is an important concern in accident scene reconstruction and investigation. Appropriate recovery of the tire impressions, through crime scene drawing, measurements, photography and casting, preserves the evidence for subsequent comparison with the alleged tires of the suspected vehicle. Many researchers and forensic experts made an approach to employ visual systematic tire-marks matching database to increase the correctness and efficiency of tire-marks identification executed by investigators at accident scene. Their database includes tire manufactures, vehicle type, and tire specifications [4,5].

Currently, there are number of approaches in the evaluation of tire marks on the crime scene. Some of these includes examination of Tread design, Tread Width, Track Width, Turning Diameter, Wheelbase and Tire Circumference [6]. In present study an attempt has been made to analyze and segregate the tire tread impressions in the cases of overlapped tire marks. The tire marks plays important and tremendously useful source of information to forensic experts. Usually, the tire marks are encountered while overlapping each other due to their aligned movement one over the other [7,8]. For instance, if a vehicle is moving in forward direction on a softer surface like sand or mud, the tire impressions of the front tires will be overlapped by the rear tires in an aligned moving condition. Vice versa will be the case when the vehicle is moving in backward direction. In these circumstances it becomes very difficult for an accident reconstructionist to accurately identify tread design of the tire for the investigative purposes. This task becomes further difficult and confusing if the front tire tread is different from the rear tire treads [9]. Therefore, a careful examination and use of image enhancing techniques can provide support during such forensic investigations.

II. MATERIALS AND METHODS

For the current study a Toyota Camry 2015 model with a tire size 205/65R16 95H has been used with a tire pressure of 33 psi in all four tires to see the uniformity in the tire impressions. The tire size indicates the 205mm nominal section width, with an aspect ratio of 65 radial ply construction, 16 inches nominal diameter, number 95 denotes the maximum load per tire and H represents a maximum speed. Deliberately the tires of different brands but of same size have been used to differentiate the overlapping for the purpose of accuracy. The tires of different brands used for the current study and further description were given in Table 1. The high-resolution photographs of the tire marks were captured by a 33mm DSLR canon camera and shown in fig. 1 to 4.

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Table 1: Shows the description of the tires considered for the study

Tire Position	Brand	Specifications	DOT number	Remarks
Front Left Tire	Hankook Optimo K40	Radial Tubeless and Made in Korea	T7U9 AK H 2916	The DOT number indicates that the tire was manufactured in the 29th week of 2016
Rear Left Tire	Good Year	Radial Tubeless and Made in Chile	M7X8 JJ1R 2215	The DOT number indicates that the tire was manufactured in the 22nd week of 2015
Front Right Tire	Falken	Ziex Radial	ZE950 2916	The DOT number indicates that the tire was manufactured in the 29th week of 2016
Rear Right Tire	Good Year	Radial Tubeless and Made in Chile	M7X8 JJ1R 2215	The DOT number indicates that the tire was manufactured in the 22nd week of 2015



Figure 2: Image of right front tire (RFT)



Figure 3: Image of left rear tire (LRT)



Figure 4: Image of right rear tire (RRT)



Figure1: Image of left front tire (LFT)

III. OBSERVATIONS AND RESULTS

To spot the findings of the overlapped tire marks, the vehicle was drove over the sandy area in order to get the complete and detailed impression of the tires. The vehicle has been driven in forward and backward direction separately on the desired surface of sand in desert area in Dubai (UAE). The high-resolution photographs and enlarged images of all the tire marks separately and overlapped tire marks were studied and examined. It was observed that even in the overlapping of the tires each individual tire mark can be sophisticatedly distinguished by studying certain class and individual characteristics. For the purpose of the study following two circumstances were considered:

A. Forward motion of the vehicle

The left rear tire (LRT) overlapping the left front tire (LFT) and shown in fig 5 and 6. The overlapping of the LRT over the LFT can be seen in figure 7. The characteristic features of the front left tire have been illustrated with red color denotations and the left back tire with green color. The overlapped tire marks can easily be distinguished among each other on the basis of these characteristic features. The right rear tire (RRT) overlapping the right front tire (RFT): The imprints of both the tires (RRT and RFT) of above-mentioned specifications have been recorded in fig. 7 and 8 through photography separately. Afterwards, the overlapping of both the tires (Figure 9) has been recorded and studied in higher magnification. The characteristic features of the front right tire have been illustrated with blue color denotations and rear right tire with yellow color.



Figure 5: Tire marks created by LRT



Figure 6: Tire marks created by LFT



Figure 7: Tire mark of Right Back Tire



Figure 8: Tire mark of Right Front Tire

B. Rearward motion of the vehicle

In this case the left rear tire (LRT) is being overlapped by the left front tire (LFT). Figure 5 and 6 are the reference image of both the tires respectively, whereas figure 10 shows the overlapping LFT by LRT. As clearly seen in figure 10 the characteristic features of both the tires can be segregated by thorough examination. The right rear tire (RRT) is being overlapped by the right front tire (RFT). Figure 7 and 8 are the reference image of both the tires respectively, whereas figure 11 shows the overlapping RRT by RFT. As clearly seen in figure 11 the characteristic features of both the tires can be segregated by thorough examination. Generally, in sandy area tire marks were easily destroyed or changed. To overcome this, photography of marks become necessary for further analysis. The forward and rearward motion of vehicle photographed and used for grudges analysis.

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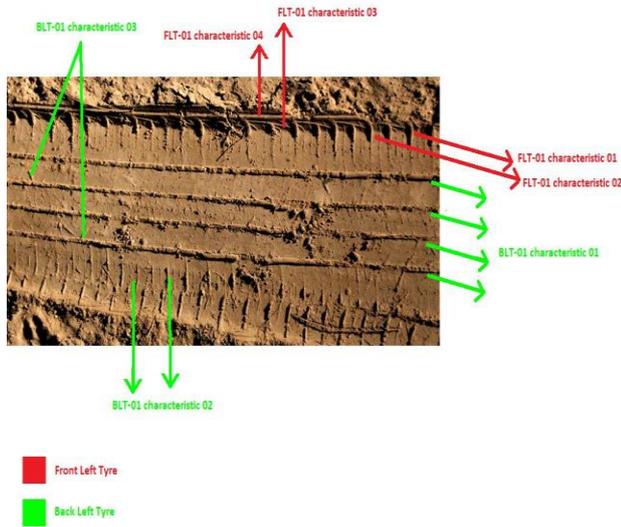


Figure 9: Distinguish features of Left Rear Tire overlapping Left Front Tire

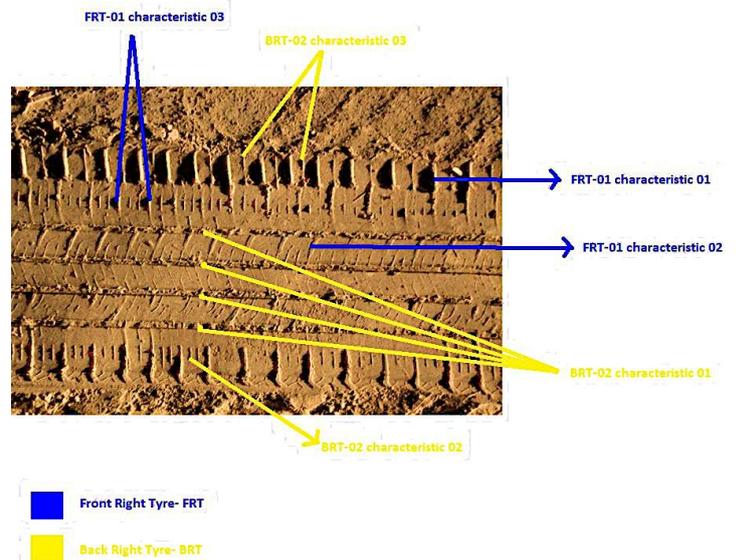


Figure 12: Examination of characteristic features of both overlapped tires (RRT & RFT)



Figure 10: Distinguish features of Right Rear Tire overlapping Right Front Tire

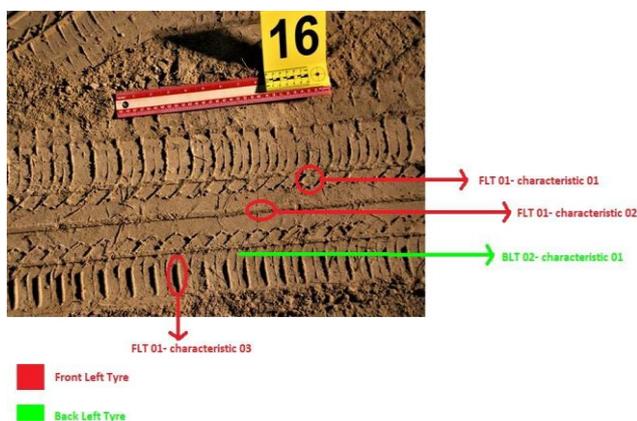


Figure 11: Examination of characteristic features of both overlapped tires (LRT & LFT)

IV. DISCUSSION

Tire impression examination is very crucial for the investigators in certain cases such as hit and run, suspected vehicle theft and traffic accidents. As the law of individuality states that no two things can be exactly alike, therefore considering this even the two tires of same make and model will suffer from different wear and tear marks depending upon number of factors like tire pressure, driving surface, weight applied, driving conditions etc. This study throws a light of using the class and individual characteristics of the tires as observed in tire impressions and their careful usages in the examination and differentiations in cases of tire overlapping which makes it slightly difficult. It has been noticed in the current study that certain characteristics will still serve as mean of identification under high resolution photographs and hence two different tires marks can be easily differentiated from each other. In both the cases, forward and rearward motion of the vehicle the overlapping of the tires have been noticed even when the vehicle is moving with a turning arc. The characteristics of both the tires in an overlapping situation have been clearly identified and differentiated.

V. CONCLUSION

Tire track evidence can be encountered in many cases including hit and run, robbery, rape and homicide. They are usually found along a dirt road, in deserted area, muddy area or near a murder victim. According to Locard's principle of exchange "Every contact leaves a trace". Therefore, at some point in time, the culprit arrived at the scene, committed the crime, and then left the scene in a vehicle. This type of evidence can provide valuable information to investigators including where the crime has occurred, the number of vehicles present, direction a vehicle etc.

Present study encompasses the use of high-resolution photographs to differentiate the class and individual characteristics of the tire impressions in case of overlapping of the tires. It has been observed that careful examination of enlarged photographs along with the actual images of the tire impressions from the alleged vehicle will provide a positive identification of the tire marks in case of overlapping.

REFERENCES

1. J.S. Baker, and L.B. Fricke, The traffic accident investigation manual, Northwestern University Traffic Institute, Evanston, Illinois, 1986.
2. Y.W. Wang, A Tire-mark Identification Scheme for Suspected Vehicle Detection in Hit and Run accident, *Journal of the Eastern Asia Society for Transportation Studies*, 2005, 6, pp. 3441 – 3452.
3. W. J. Bodziak, Tire Tread and Tire Track Evidence Recovery and Forensic Examination, CRC Series in Practical Aspects of Criminal and Forensic Investigations, 2008.
4. F.W. Baumann, H.H. Schreier, and D.Simmerbacher, Tire Mark Analysis of a Modern Passenger Vehicle With Respect To Tire Variation, Tire Pressure And Chassis Control Systems; In Sae Paper 2009-01-100, Sae International, 2009.
5. G. Seipel, R. Kitzte, and H. Winner, Portable Test Facility for Determining Tire-Marking Sensitivity; Tire Technology International-Annual Review, 2011, p. 67-68.
6. H. Sakai, and K. Araki, Thermal Engineering Analysis of Rubber Vulcanization and Tread Temperatures During Severe Sliding of a Tire; TSTCA, 1999, p. 22-47.
7. K.A. Grosch, Rubber Abrasion and Tire Wear; in Fall Rubber Division, Fall Rubber Division, ACS, Cleveland, OH, 2008, p. 470-505.
8. C.P. Dickerson, M.W. Arndt, S.M. Arndt, and G.M. Mowry, Evaluation of Vehicle Velocity Predictions Using the Critical Speed Formula, Paper 950137, SAE International Congress, Detroit, MI, 1995.
9. R.F. Lambourn, The calculation of Motor Car Speeds from Curved Tyre Marks, *Journal of Forensic Science Society*, 1989, 29, p. 371-386.

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Dr. Bhoopesh Kumar Sharma, Ph.D (Chemistry) is an Assistant Professor and Programme Head, Forensic Science at Amity University Dubai with 14+ years of experience in Teaching, Research and project supervision in various areas of Forensic Science including fingerprints, questioned document analysis, ballistics, and crime scene investigation. Has solved a large number of

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