UDC 629.01 DOI: 10.30977/AT.2219-8342.2025.56.0.04

Variability in the interpretation of information in the investigation of road traffic incidents using 3D scanning devices

Leontiev D.[1], Varlakhov V.[2], Frolov A.[1,2], Danets S.[1,3], Don Ye.[1,4]

[1] Kharkiv National Automobile and Highway University, Ukraine
[2] National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute», Ukraine
[3] Kharkiv State Research and Forensic Science Center of the MIA of Ukraine, Ukraine
[4] Kharkiv Mechanical Engineering College, Ukraine

Annotation. Problem. *One of the key challenges in the investigation of road traffic accidents (RTAs) is the reliable determination of the collision mechanism between vehicles, especially in cases where the vehicles have been moved from the scene. Traditional methods of documentation and analysis often lack sufficient accuracy and objectivity.* ***Goal.*** *The aim of this study is to identify the mechanism of collision between two vehicles by analyzing and comparing their geometric damage patterns obtained via 3D scanning, followed by determining their actual relative positioning at the moment of initial contact.* ***Methodology.*** *To achieve this goal, a portable 3D scanner Artec Leo was used, enabling high-precision scanning of vehicles regardless of their location. The resulting 3D models of the damaged vehicles were aligned with each other and with a digital version of the accident scene diagram. During the analysis, vehicle orientation angles, the location of primary contact, movement directions, and damage characteristics were determined.* ***Results.*** *It was established that the collision occurred at an angle of 8–10° within the driving lane of vehicle 1. This conclusion is supported by the alignment of damage areas, the position of the front right headlamp of vehicle 1, and the distribution of glass and plastic fragments. The zone of initial contact was localized within 2 meters from the right edge of the carriageway.* ***Originality.*** *An integrated approach to digital traffic accident reconstruction using 3D scanning is proposed, allowing for accurate analysis even without access to the original accident scene.* ***Practical value.*** *The methodology can be applied in forensic vehicle examination, court investigations, and insurance case assessments to objectively determine the circumstances of a traffic collision.*

Key words: *3D scanning, Road traffic incidents (RTIs), Road traffic accidents (RTAs), Collision reconstruction, Collision mechanism, Modelling, Vehicle technical expertise, Damage geometry.*

Introduction

In the current context of an increasing number of road traffic incidents (RTIs), improving the methods for recording and investigating the circumstances of their occurrence is of particular importance. The objectivity and comprehensiveness of the analysis of RTI circumstances, especially during automotive technical and transport-trace examinations, largely depend on the accuracy of collecting initial data at the scene. The key informative elements to be recorded during the inspection of the accident scene include: the final position of the vehicles; the nature and extent of their mechanical damage; tire trace evidence on the road surface; the distribution of debris, dust, and soil at the scene; and other material traces that are essential for reconstructing the mechanism of the incident.

It is known that the use of traditional photo and video recording tools does not always ensure the required precision and completeness of information, which complicates the subsequent analysis of the incident mechanism, and in some cases may lead to biased conclusions. In this context, the introduction of modern recording methods, such as 3D scanning technology, opens new possibilities for conducting investigations with a high level of detail regarding the initial conditions of RTI causation. The generation of a point cloud that captures the spatial positioning of objects or items around the damaged vehicles makes it possible to obtain not only the dimensions of all visible objects directly from the digital model, but also to form a general picture of the interaction patterns among all objects involved in the incident.

It should be noted that the nature of recorded damage to the objects involved in the incident does not always provide a definitive answer regarding the mechanism of their interaction. Therefore, this issue requires further research and remains highly relevant in today's context.

Analysis of publications

Analysis of the issue of investigating the circumstances of road traffic accidents (RTAs) shows that in modern investigative practice, three-dimensional (3D) scanning technologies are increasingly being used to document the accident scene. These technologies allow for the creation of highly accurate digital models that capture the geometry of objects at the accident site and the traces left behind after the collision.

According to the study by Pagounis et al. [1], terrestrial laser scanning enables rapid and safe data collection without the need to stop traffic near the accident site, even under poor lighting conditions. It is evident that 3D scanning of accident scenes provides advantages over other recording methods, as it allows for precise comparison and measurement of damage. This, in turn, makes it possible to determine even the angles of interaction between the objects involved in the RTA. For instance, the research conducted by Lyu et al. [2] demonstrates how 3D scanning data can be used to model the angles of vehicle collisions, thereby contributing to a more accurate analysis of accident circumstances.

In addition, modern mobile devices equipped with LiDAR technology [3], such as iPhones using the Recon-3D application, allow for quick and efficient documentation of RTA scenes without specialized training, making the technology more accessible to a broader range of users. However, implementing 3D scanning in accident investigations also poses certain challenges. In particular, a study conducted in China [4] highlights the limitations of using unmanned aerial vehicles (UAVs) with LiDAR in low-light conditions and emphasizes the need to combine them with mobile scanners to obtain a complete picture of the scene.

Overall, the scientific publications [1–4] confirm the effectiveness of 3D scanning in investigating the circumstances of RTIs, especially in terms of measurement accuracy, data collection speed, and the ability to generate detailed visualizations for analysis and presentation in court [5-11]. Nonetheless, full-scale implementation of this technology requires overcoming technical and organizational barriers, including equipment costs and the need to standardize data processing methods, particularly given the wide range of available 3D scanning devices [12-16].

Objective and Problem Statement

The aim of the study is to identify of the collision mechanism between two vehicles by analyzing and comparing their geometric damage obtained through 3D scanning, followed by determining their actual relative position at the moment of initial contact.

To achieve the stated aim, the following tasks must be completed:

1. Analyze the results of 3D scanning of individually damaged vehicles: determine the nature, localization, and geometric parameters of the mechanical damage on each vehicle; identify approximately corresponding contact areas for further comparison.

2. Investigate the specifics of aligning the damaged vehicles with each other: perform virtual alignment of the 3D models to analyze the compatibility of the damaged zones and determine possible angles of relative positioning at which the damage on both vehicles correlates.

3.Determine the features of placing the aligned vehicles at the presumed collision site: reconstruct the spatial position of the vehicles within the roadway based on witness testimony or evidence indicating the accident location; take into account trace evidence, directions of movement, and spatial constraints of the road environment.

4. Evaluate the results of the alignment and interpret the obtained vehicle positions: identify a set of possible collision mechanisms that correspond to the damage configuration; perform a preliminary reconstruction of the event scenarios based on the consistency between physical traces and the results of 3D model comparison.

Analyze the results of 3D scanning of individually damaged vehicles

It is known that 3D scanning of damaged vehicles can be performed under two conditions:

– at the scene of the road traffic accident, in its actual condition and location, during the documentation of the circumstances of the incident;

– at the impound lot, where the damaged vehicle was relocated after all the circumstances of the road traffic accident have been documented.

Regardless of the conditions under which 3D scanning of damaged objects is performed, the objectivity of the generated spatial field remains consistent and cannot be questioned—except in cases where additional significant damage occurs during the transportation of the damaged objects or is intentionally inflicted at the impound lot. However, it should be noted that such cases must be prevented by supervisory authorities (e.g., the police or the security service of the impound lot).

Let us consider a typical case of 3D scanning of damaged passenger vehicles (Fig. 1 and 2) resulting from a frontal collision.

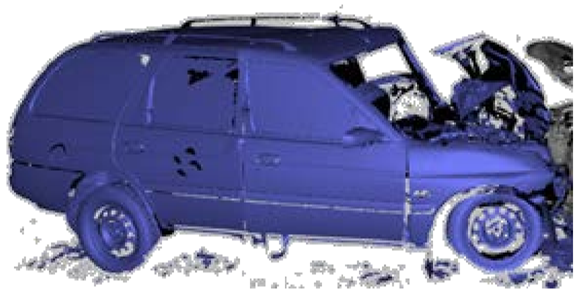
a

b

Fig. 1. Damaged passenger vehicle 1: a – photograph of the vehicle's condition; 2 – 3D spatial field corresponding to the visual condition of damaged vehicle 1

The comparison of 3D scanning results of the damaged vehicles (see Fig. 1a and b, as well as Fig. 2a and b) demonstrates that they accurately reflect the actual deformation sustained by the vehicles as a result of the frontal collision during the road traffic accident. Therefore, the further use of the 3D spatial field is objective and can be reliably employed in subsequent investigations to clarify the circumstances of the accident.

a



b

Fig. 2. Damaged passenger vehicle 2: a – photograph of the vehicle's condition; 2 – 3D spatial field corresponding to the visual condition of damaged vehicle 2

To obtain the 3D spatial field of the damaged vehicles in this study, the "Artec Leo 3D scanner" device was used (Figure 3), which has the following technical specifications (Table 1).

a b

Fig. 3. Artec Leo 3D scanner: a – front view of the scanner; b – rear view of the scanner

Table 1. Technical characteristics of the Artec Leo 3D scanner

Scanner type	Handheld
3D accuracy	up to 0.1 mm
3D resolution	up to 0.5 mm
Accuracy depending on distance,	up to 0.03% at 100 cm
Working distance	0.35 – 1.2 m
Capture volume area	160 000 cm³
Linear field of view at close range (H × W)	244 × 142 mm
Linear field of view at far range (H × W)	838 × 488 mm
Angular field of view (H × W)	38.5 × 23 °
Texture reading	Available
Texture resolution	2.3 MP
Color rendering	24 bpp
3D reconstruction speed for real-time alignment	up to 22 fps
3D reconstruction speed for 3D video	up to 44 fps
3D reconstruction speed in 3D video stream mode	up to 80 fps
Data acquisition speed	up to 3 million points/sec
3D and 2D exposure time	0.0002 sec
3D illumination	VCSEL
2D illumination	White 12-LED matrix
Interface	Wi-Fi, Ethernet, SD card
Built-in hard drive	256 GB SSD
3D mesh formats	OBJ, PLY, WRL, STL, AOP, ASC, PTX, E57, XYZRGB
3D point cloud formats	BTX, PTX
CAD formats	STEP, IGES, x_t
Measurement formats	CSV, DXF, XML

The Artec Leo scanner is equally capable of capturing both large areas and the finest surface details or elements. When used at the scene of a road traffic accident, as opposed to being used at an impound lot, it significantly increases the amount of information available for automotive technical examination by recording small details scattered on the roadway or shoulder in the area where the vehicles involved in the accident were located.

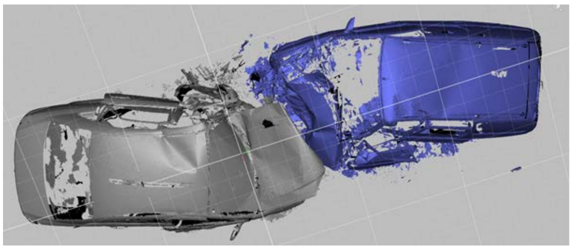
The specifics of aligning the damaged vehicles with each other

The alignment of two scanned vehicles using the Artec Leo scanner is a creative process aimed at analyzing and visualizing the damage zones resulting from a vehicle collision.

Thanks to the high accuracy and 3D resolution of the Artec Leo scanner (see Table 1), a traffic accident reconstruction expert can meticulously compare the geometry of deformations on each vehicle in order to accurately determine the contact surfaces involved in the crash.

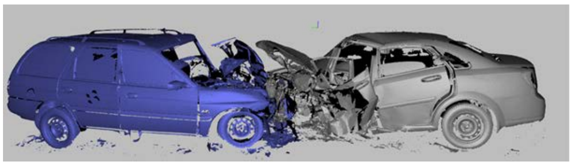
A distinctive feature of this process is the ability to virtually align the resulting 3D models of the vehicles (see Fig. 1b and Fig. 2b) within a shared space (Fig. 4) using specialized software included with the Artec Leo scanner.

In addition, the scanner's color texture capture and scanning precision allow the expert to account for even minor damages, which may play a critical role in identifying the actual mechanism of the traffic accident.



a

b



c

Fig. 4. Aligning the damaged vehicles with each other: a – view from above; b – view from the right side; c – view from the left side

As shown in Figure 4, the three-dimensional alignment of damaged vehicles allows for the examination of body deformations from various perspectives – including top, left, right, and other angles.

This approach eliminates the possibility of subjectively positioning the two vehicles relative to one another and enables a more detailed analysis of the deformation mechanisms of the vehicle body elements resulting from their collision.

The features of placing the aligned vehicles at the presumed collision site

To determine the possible point of collision between the vehicles, let us analyze the diagram showing their final positions after the road traffic accident.

According to a copy of the scene sketch included in the official inspection report documented by the police, Vehicle 2 (see Fig. 1 a) was positioned such that the distance from its front left wheel to the road edge measured 8.5 meters, and the distance from the rear left wheel to the road edge was 7.5 meters.

Vehicle 1 (see Fig. 2a) was positioned with its front right wheel located 4.1 meters from the nearest edge of the carriageway and its rear right wheel at a distance of 6.5 meters from the same edge.

Glass and plastic debris (see Fig. 5) was found in the traffic lane of Vehicle 1, ranging from 2.9 meters from the carriageway edge to 8.5 meters wayside of it.

The right headlamp of Vehicle 1 (see Fig. 5) was located wayside the carriageway, 1.8 meters from its edge.

A soil scrape (see Fig. 5), 1.5 meters in length, begins at a distance of 3.5 meters from the edge of the road and ends near the front right wheel of Vehicle 1 (see Fig. 5).

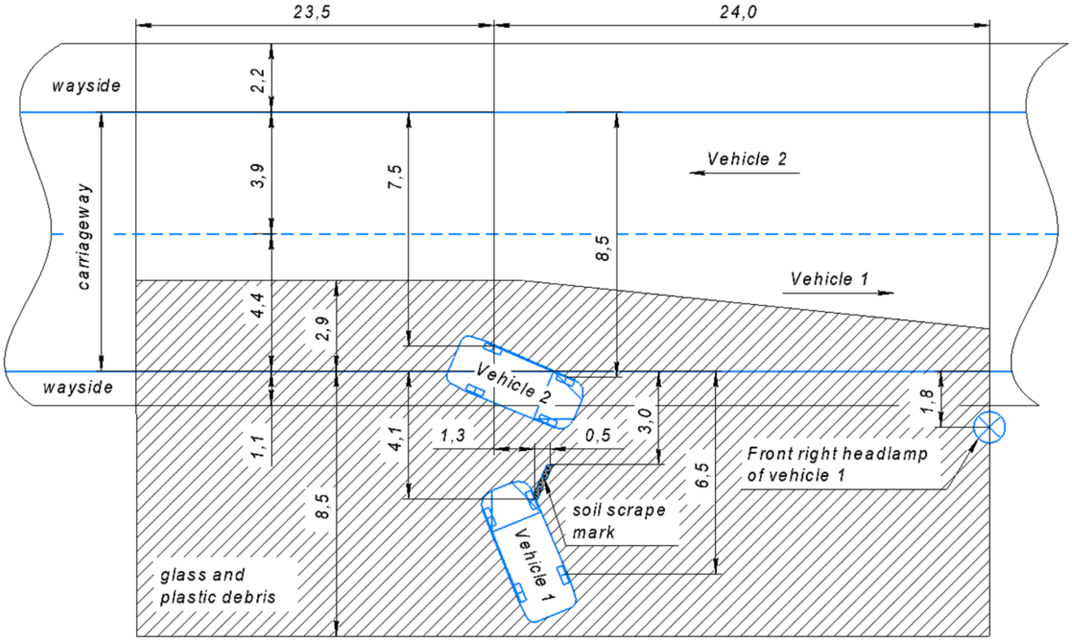


Fig. 5. Copy of the scene diagram from the road traffic accident inspection report

From the road traffic accident diagram, it is evident that the collision between the vehicles occurred in the lane of Vehicle 1.

The position of the front right headlamp of Vehicle 1 indicates that, at the moment of collision, the vehicle was positioned at an angle relative to its lane. This is supported by the fact that the headlamp was displaced 1.8 meters to the right, onto the shoulder of the road, due to the impact. It should be noted that the headlamp was located 23 meters away from the final resting position of the front right part of Vehicle 1 (see Fig. 5).

Furthermore, since the headlamp was displaced in the direction of Vehicle 1's movement over a considerable distance (at least 50% of the 24-meter distance), it can be concluded that Vehicle 1 was in motion and not stationary at the time of collision with Vehicle 2.

The comparison of the 3D models (see Fig. 4 a) of the vehicles with one another and with the road traffic accident diagram (see Fig. 5) allows for the reconstruction of the collision mechanism by forming tangent motion trajectories-such as those of the damaged vehicles' front wheels-illustrated by dashed lines with two dots (see Fig. 6).

From Figure 6, it can also be seen that the relative position of the vehicles corresponds not only to the final positions of the damaged vehicles but also to the final location of the front right headlamp of Vehicle 1.

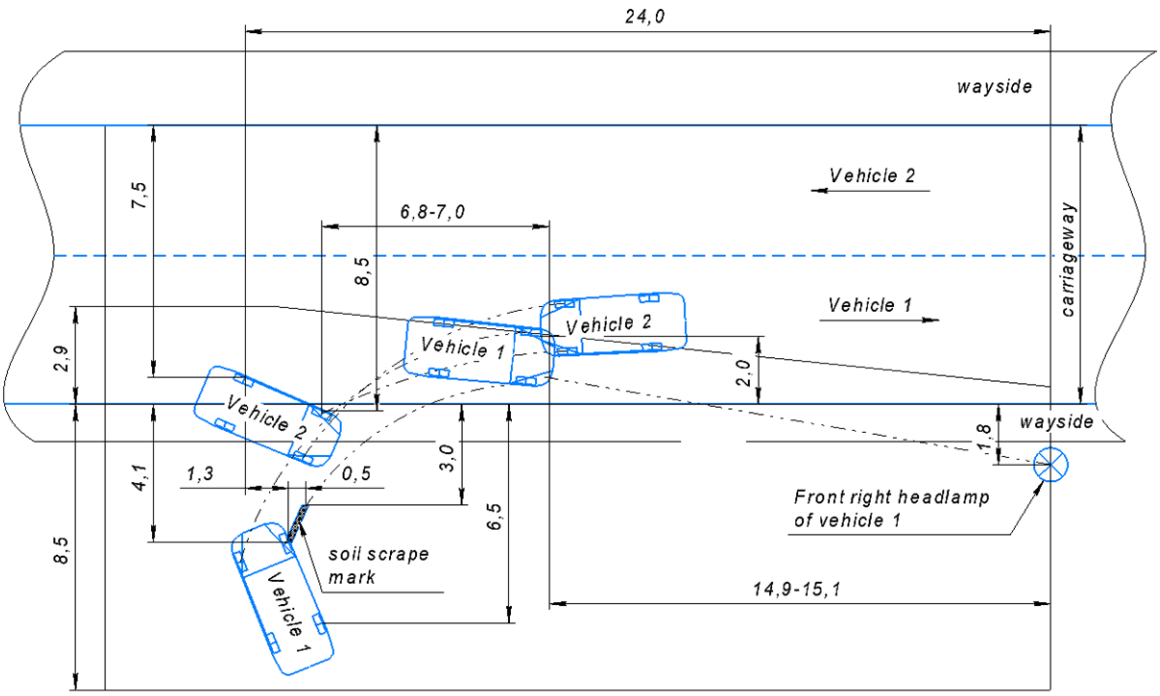


Fig. 6. Reconstruction of the vehicle collision mechanism based on the post-impact positioning diagram, 3D alignment models of the vehicles, the location of vehicle 1's front right headlamp, and the distribution of glass and plastic debris

Thus, the constructed diagram (Fig. 6) indicates an approximate collision point of the two vehicles, which is located 6.8-7.0 meters from the final position of the front left wheel of Vehicle 2, or 14.9-15.1 meters from the final location of Vehicle 1's front right headlamp on the carriageway.

The pattern of glass and plastic debris on the carriageway surface suggests that the collision occurred no more than 2.0 meters from the right edge of the traffic lane in the direction of Vehicle 1's movement (see Fig.6).

Identification of the specific features of the vehicle collision mechanism

Based on the collision reconstruction diagram (see Fig. 6), we will attempt to determine the angle of impact between the vehicles and their respective orientations relative to the lane dividing line for opposing traffic flows.

To achieve this, we will use a graphical method in a CAD system to measure the angles between the longitudinal axes passing through the centers of mass of the two vehicles and the line separating the opposing traffic flows (see Fig. 7).

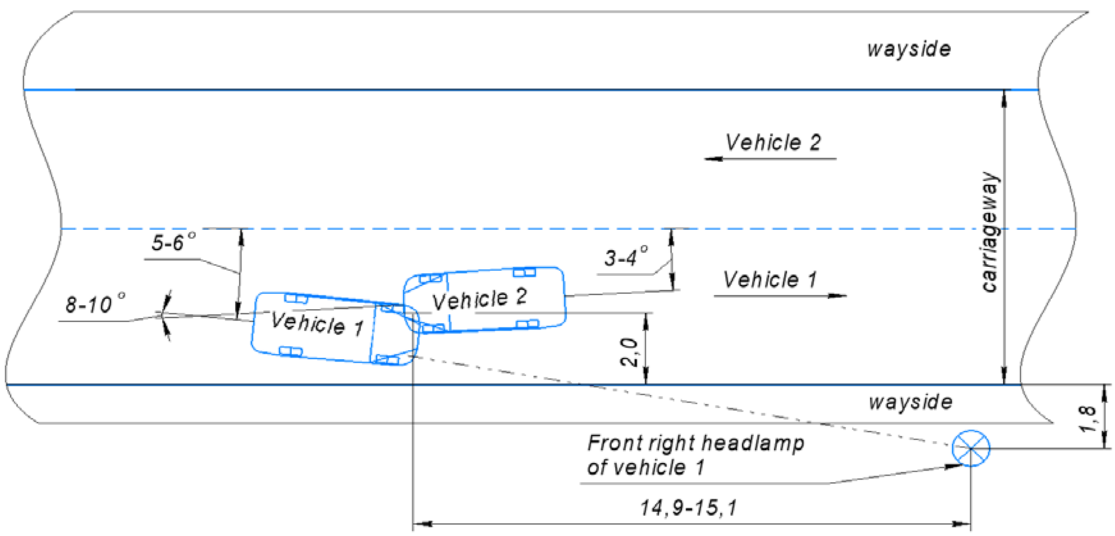


Fig. 7. Diagram for Determining the Collision Angle of the Vehicles

From the diagram shown in Figure 7, it can be seen that the collision angle of the vehicles in the lane of Vehicle 1 was approximately 8-10 degrees. This angle resulted from the positioning of Vehicle 1 at an angle of 5-6 degrees relative to the line dividing the opposing traffic flows, and Vehicle 2 being positioned at an angle of 3-4 degrees to the same line. It is evident that, immediately before the collision, both drivers attempted to maneuver to avoid the crash. However, the maneuvering direction chosen by the driver of Vehicle 2 was incorrect, which ultimately led to the traffic accident. It should be noted that the width of the lane of Vehicle 1 was sufficient to avoid the accident, had the driver of Vehicle 2 taken action to steer toward the lane corresponding to his direction of travel.

Thus, the conducted study demonstrates that the use of modern 3D scanning devices makes it possible to reliably determine the mechanism of a vehicle collision, even if the vehicles have been moved to an impound lot and it is not possible to align the damaged vehicles at the scene of the traffic accident.

Conclusion

Based on the conducted investigation, the following conclusions can be made:

1. The use of 3D scanning devices makes it possible to reproduce vehicle damage with high precision, regardless of the scanning location (either at the scene of the accident or at an impound lot), ensuring the objectivity of the collision mechanism reconstruction during the traffic accident event.

2. The refined scanning data and alignment of the vehicles allowed for the determination of the collision angle (8-10 degrees), which resulted from the orientation of the vehicles relative to the centerline dividing the opposing traffic flows. This indicates a partial angular contact between the front parts of the vehicles, despite the initial impression of a frontal collision based on the visible damage.

3. By aligning the accident scene diagram with the 3D model of the damaged vehicles, the probable point of collision was established: 6.8–7.0 meters from the front left wheel of vehicle 2 and 14.9–15.1 meters from the location where the front right headlamp of vehicle 1 was found, and no farther than 2 meters from the right edge of the carriageway in vehicle 1's direction of travel.

This made it possible to localize the primary contact zone.

4. The distribution of glass and plastic remains, recorded within 2.9–8.5 meters from the edge of the carriageway on vehicle 1's traffic lane, confirms that the collision occurred precisely within the lane of vehicle 1.

5. The displacement of the right headlamp of vehicle 1 by 1.8 meters toward the roadside indicates that vehicle 1 was moving at the moment of collision with vehicle 2 and was not stationary.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

1. Pagounis, V., Stathas, D., & Tsakiri, M. (2006). 3D Laser Scanning for Road Safety and Accident Reconstruction. Retrieved from https://www.researchgate.net/publication/237627842_3D_Laser_Scanning_for_Road_Safety_and_Accident_Reconstruction
2. Lyu, Y., Zhang, W., Zhang, H., Wang, K., & Li, Q. (2017). 3D laser scanning and modeling of vehicle collision for accident reconstruction. Sensors, **17(3)**, 482. https://doi.org/10.3390/s17030482
3. DeWitt, K., Sherry, L., Mckenzie, L. A., Ritchie, M., & Sutter, J. (2023). Recon-3D: A mobile LiDAR photogrammetry application for rapid documentation of road traffic crashes. Forensic Science International: Reports, **5**, 100329. https://doi.org/10.1016/j.fsir.2023.100329
4. Zhang, Y., Zhou, Y., Xie, X., Hu, H., & Lin, X. (2023). Study on the effectiveness of LiDAR scanning using UAV and mobile platform in traffic accident scene reconstruction. Vehicles, **5(3)**, 423–437. https://doi.org/10.3390/vehicles5030024
5. Рябушенко О. Данець С. & Скляров М. (2022). Дослідження швидкостей руху транспортних засобів з використанням даних відеоспостереження. *Сучасні технології в машинобудуванні та транспорті*, **2(19)**, 182-190. Riabushenko O. Danets S. & Skliarov M. (2022). Doslidzhennia shvydkostei rukhu transportnykh zasobiv z vykorystanniam danykh videosposterezhennia [Research on vehicle speeds using video surveillance data]. *Suchasni tekhnolohii v mashynobuduvanni ta transporti*, **2(19)**, 182-190.
6. Данець С. В. (2018). *Оцінка параметрів руху транспортних засобів при реконструкції дорожньо-транспортних пригод* (автореферат дисертації, Харківський національний автомобільно-дорожній університет). Danets S. V. (2018). *Otsinka parametriv rukhu transportnykh zasobiv pry rekonstruktsii*

dorozhno-transportnykh pryhod [Assessment of vehicle movement parameters during road accident reconstruction] (abstract dissertation, Kharkiv national automobile and highway university).
7. Danets, S. V. (2014). Application of the latest laser scanning technologies during the inspection of the accident site. *Forensic Bulletin*, **2(22)**, 166-171.
8. Сараєв О. В. & Данець С. В. (2014). Використання прикладних комп'ютерних програм при дослідженні дорожньо-транспортної пригоди. *Наукові нотатки*, **(45)**, 492-499. Saraiev O. V. & Danets S. V. (2014). Vykorystannia prykladnykh kompiuternykh prohram pry doslidzhenni dorozhno-transportnoi pryhody [Using applied computer programs in the investigation of a traffic accident]. *Naukovi notatky*, **(45)**, 492-499.
9. Сараєв О. В. (2013). Новітні технології дослідження обставин дорожньо-транспортної пригоди. *Вісник Національного транспортного університету*, **(28)**, 405-414. Saraiev O. V. (2013). Novitni tekhnolohii doslidzhennia obstavyn dorozhno-transportnoi pryhody [The latest technologies for investigating the circumstances of a traffic accident]. *Visnyk Natsionalnoho transportnoho universytetu*, **(28)**, 405-414.
10. Туренко А. М., Клименко В.І., Сараєв О.В., Данець С.В. (2013). *Автотехнічна експертиза. Дослідження обставин ДТП.* Turenko A. M., Klymenko V.I., Saraiev O.V., Danets S.V. (2013). *Avtotekhnichna ekspertyza. Doslidzhennia obstavyn DTP* [Automotive technical examination. Investigation of the circumstances of the accident].
11. Махлай, С. М., & Леонтьєв, Д. М. (2018). Визначення зупинного шляху автомобіля, що обладнаний антиблокувальною системою. *Вісник ОНДІСЕ*, **4**, 44-50. Leontiev D. M., Makhlai S. M. (2018) Vyznachennia zupynnoho shliakhu avtomobilia, shcho obladnanyi antyblokuvalnoiu systemoiu [Determination of the stopping distance of a vehicle equipped with an anti-lock braking system]. *Visnyk Odeskoho naukovo-doslidnoho instytutu sudovoi ekspertyzy*. **4**, 44-50.
12. Данець, С. В. (2013). Особливості проведення транспортно-трасологічних експертиз у випадку, коли транспортні засоби, що досліджуються, знаходяться у різних місцях. *Криміналістичний вісник*, **(2)**, 144-147. Danets, S. V. (2013). Osoblyvosti provedennia transportno-trasolohichnykh ekspertyz u vypadku, koly transportni zasoby, shcho doslidzhuiutsia, znakhodiatsia u riznykh mistsiakh [Peculiarities of conducting transport and track examinations in the case when the vehicles being examined are located in different locations]. *Kryminalistychnyi visnyk*, **(2)**, 144-147.
13. Данець С. В. (2013). Застосування автоматизованих засобів дослідження обставин ДТП. *Вісник Харківського національного автомобільно-дорожнього університету*, **(61-62)**, 190-194. Danets S. V. (2013). Zastosuvannia avtomatyzovanykh zasobiv doslidzhennia obstavyn DTP [Application of automated means of investigating the circumstances of a traffic accident]. *Visnyk Kharkivskoho natsionalnoho avtomobilno-dorozhnoho universytetu*, **(61-62)**, 190-194.
14. Saraiev O., Voropay A., Koriak O., Povaliaiev S. & Sharapata A. (2022). Construction of a Mathematical Model of Vehicles Tangent Collision during Reconstruction of the Circumstances of a Road Accident. *Eastern-European Journal of Enterprise Technologies*, **6(3)**, 120.
15. Povalyaev S. & Saraiev O. (2019). Modeling of the mechanism of vehicle overturning in the process of development of road traffic accident. *Theory and Practice of Forensic Science and Criminalistics*, **20(2)**, 320-328.
16. Сараєв О.В. (2018). *Метод оцінки ефективності гальмування транспортних засобів при дослідженні ДТП.* (автореферат дисертації, Харківський національний автомобільно-дорожній університет). Saraiev O.V. (2018). *Metod otsinky efektyvnosti halmuvannia transportnykh zasobiv pry doslidzhenni DTP* [Method for assessing vehicle braking efficiency in road accident research]. (abstract dissertation, Kharkiv national automobile and highway university).

Leontiev Dmytro [1], D. Sc. (Eng), Prof. Departament of Automobiles named after A. B. Gredeskul,
e-mail: dima.a3alij@gmail.com,
Phone.: +38(095) 903-68-88,
ORCID: http://orcid.org/0000-0003-4255-6317
Varlakhov Vitalii [2]**,** PhD, head of the engineering and technical research laboratory,
e-mail: 19varlahov84@gmail.com
ORCID: https://orcid.org/0000-0001-6446-4400
Frolov Andrii [1,2], PhD, assistant, leading researcher, forensic expert, assistant Depart. of Automobiles named after A. B. Gredeskul,
e-mail: frolov.andrey.5120@gmail.com ,
Phone.: +38(098) 826-21-98,
ORCID: http://orcid.org/0000-0002-3868-4511
Danets Serhii [1,3], C. Sc. (Eng), Assoc. Prof. Depart. of Automobiles named after A. B. Gredeskul, First deputy director, Kharkiv State Research and Forensic Science Center of the Ministry of Internal Affairs of Ukraine,
e-mail: danez@ukr.net ,
ORCID: https://orcid.org/0000-0003-4155-1856
Don Evgeny [1,4]**,** C. Sc. (Eng), Assoc. Prof. Depart. of Automobiles named after A. B. Gredeskul,
e-mail: evgenypj82@gmail.com,
Phone.: +38(067) 729-98-20;
ORCID: https://orcid.org/0000-0002-1508-8397

[1] Kharkiv National Automobile and Highway University Yaroslava Mudrogo str., 25, Kharkiv, Ukraine, 61002

[2] National Scientific Center «Hon. Prof. M. S. Bokarius Forensic Science Institute», str. Zolochivska, 8A, Kharkiv, Ukraine, 61177
[3] Kharkiv State Research and Forensic Science Center of the Ministry of Internal Affairs of Ukraine, str. Kovtuna, 34, Kharkiv, Ukraina, 61036
[4] Kharkiv Mechanical Engineering College, str. Plekhanivska, 79, Kharkiv, Ukraine, 61001

Варіативність інтерпретації інформації під час розслідування дорожньо-транспортних подій з використанням 3D-скануючих пристроїв

Анотація. Проблема. *Однією з ключових проблем при розслідуванні дорожньо-транспортних подій (ДТП) є встановлення достовірного механізму зіткнення транспортних засобів, особливо у випадках, коли автомобілі переміщені з місця події. Традиційні методи фіксації та аналізу часто не забезпечують достатньої точності та об'єктивності.* ***Мета****. Метою дослідження є ідентифікація механізму зіткнення між двома транспортними засобами шляхом аналізу та порівняння їхніх геометричних пошкоджень, отриманих за допомогою 3D-сканування, з подальшим визначенням їх фактичного відносного розташування в момент початкового контакту.* ***Методологія****. Для досягнення поставленої мети застосовано портативний 3D-сканер Artec Leo, який дозволяє виконувати високоточне сканування транспортних засобів незалежно від місця їх розташування. Побудовані 3D-моделі ушкоджених автомобілів були зіставлені між собою, а також з цифровою схемою дорожньо-транспортної пригоди. В процесі аналізу було визначено кути орієнтації ТЗ, місце первинного контакту, напрямки руху та характер пошкоджень.* ***Результати****. Встановлено, що зіткнення відбулося під кутом 8–10° на смузі руху транспортного засобу 1, що підтверджується співставленням місць пошкоджень, положенням передньої правої фари транспортного засобу 1, а також осипом скла й пластику. Локалізовано зону первинного контакту на відстані до 2 м від правого краю проїзної частини.* ***Оригінальність****. Запропоновано інтегрований підхід до цифрової реконструкції ДТП з використанням 3D-сканування, що дозволяє виконувати точний аналіз навіть без доступу до місця події.* ***Практична цінність.*** *Методика може бути використана в експертній автотехнічній практиці, судових розслідуваннях та страхових справах для об'єктивного встановлення обставин ДТП.*

Ключові слова: *3D-сканування; Дорожньо-транспортна подія (ДТП); Дорожньо-транспортна пригода (ДТП); Реконструкція зіткнення; Механізм зіткнення; Моделювання; Автотехнічна експертиза; Геометрія пошкоджень.*

Леонтьєв Дмитро Миколайович[1], д.т.н., проф., професор кафедри автомобілів ім. А. Б. Гредескула,
e-mail: dima.a3alij@gmail.com,
тел.: +38(095) 903-68-88,
ORCID: http://orcid.org/0000-0003-4255-6317
Варлахов Віталій Олександрович[2], PhD, завідувач лабораторії інженерно-технічних досліджень Національного наукового центру «Інститут судових експертиз ім. Засл. проф. М. С. Бокаріуса»
e-mail: 19varlahov84@gmail.com
ORCID: https://orcid.org/0000-0001-6446-4400
Фролов Андрій Анатолійович[1,2], PhD, ассистент кафедри автомобілів ім. А. Б. Гредескула Харківського національного автомобільно-дорожнього університету, провідний науковий співробітник, судовий експерт Національного наукового центру «Інститут судових експертиз ім. Засл. проф. М. С. Бокаріуса»
e-mail: frolov.andrey.5120@gmail.com ,
тел.:+38(098) 826-21-98,
ORCID: http://orcid.org/0000-0002-3868-4511
Данець Сергій Віталійович [1,3], к.тн., доцент кафедри автомобілів ім. А. Б. Гредескула, перший заступник директора Харківського науково-дослідного експертно-криміналістичного центру Міністерства внутрішніх справ України,
e-mail: danez@ukr.net,
ORCID: https://orcid.org/0000-0003-4155-1856
Дон Євген Юрійович[1,4], к.т.н., доцент кафедри автомобілів ім. А. Б. Гредескула Харківського національного автомобільно-дорожнього університету,
e-mail: evgenypj82@gmail.com,
тел.: +38 (067) 729-98-20;
ORCID: https://orcid.org/0000-0002-1508-8397

[1] Харківський національний автомобільно-дорожній університет, вул. Ярослава Мудрого, 25, м. Харків, Україна, 61002
[2] Національний науковий центр «Інститут судових експертиз ім. Засл. проф. М. С. Бокаріуса», вул. Золочівська, 8А, м. Харків, Україна, 61177
[3] Харківський науково-дослідний експертно-криміналістичний центр Міністерства внутрішніх справ України, вул. Ковтуна, 34, м. Харків, Україна, 61036
[4] Харківський машинобудівний фаховий коледж, вул. Плеханівська, 79, м. Харків, Україна, 61001