

Signs of reprinting are discrepancies in the location of printed characters in relation to lines, differences in the size and configuration of printed characters of the same name, differences in the microstructure of strokes of printed texts, differences in defects inherent in printed devices.

Signs of replacing parts of the document. In many documents, photo cards, sheets, numbers and series of documents can be replaced. Both a photo card and sheets can be replaced in identity documents. The replacement of the photo card can be done in different ways: in its entirety, leaving the part with the imprint of the seal or separating the emulsion layer. Missing parts of imprints of mystical and metal seals are placed on the pasted photo card by overdrawing and pressure. The use of ultraviolet rays can reveal differences in the luminescence of the paper and the dye of the strokes of the text, etc. [1].

The most common way of making changes to a document is to make impressions of seals and stamps by mounting or imitating in various ways. In expert practice, a number of methods of applying seals and stamps are known, in particular, copying from another document, mounting using two different clichés, using computer technologies and printing equipment (electrophotographic method, inkjet method, etc.), making a home-made cliché. Research of seal impressions and stamps consists in the study of general and specific features. Common features characterize group features, and their own — individual features that make it possible to identify the object.

The study of signatures with preliminary technical preparation in documents requires, first of all, establishing the method of its execution. The technical reproduction of a signature should be understood as its implementation using technical

techniques in order to obtain the maximum similarity with the real one.

The fastest way to reproduce a signature is to imitate it using computer and duplicating equipment. So, after scanning the signature, processing it with a special program, it is printed on the required document. Such a signature will be flat, with uneven edges, have variable stroke widths, breaks in strokes and discrete structure, etc. Such a technique leaves behind individual signs caused by the specifics of the work of trace-forming components (for example, a cartridge), structural features of the equipment, and signs that appeared during operation [2].

As a result of the above, it can be concluded that during the examination of the main ways of changing the primary content of documents, the authors identified and supplemented the most common ways and analyzed their special features. We also considered the ways of their establishment, considered a number of specialized terms, without knowledge of which it is impossible to conduct a complete and high-quality research. The analysis of this issue is that the use of various methods, methods, various devices, materials, modern equipment and the emergence of new technologies makes it possible to detect the facts of changes to documents in a timely manner during research and examinations.

References

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«Bosch crash data retrieval system» — aspects of practical use in car accidents investigations

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This article presented the necessity to use modern equipment to get reliable data for vehicle accident reconstruction.

Keywords: event data recorder; vehicle; crash data retrieval; speed; report; investigation.

Система «Bosch crash data retrieval» — аспекти практичного використання під час розслідування ДТП

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Ця робота представляє необхідність використання сучасного обладнання для отримання достовірних даних для реконструкції ДТП.

Ключові слова: реєстратор даних про події, транспортний засіб, пошук даних про ДТП, швидкість, звіт, розслідування.

During forensic car accident investigation, it is possible to determine the mechanism of a traffic accident after a vehicle collision examining the traces and marks left at the place of the accident, as well as the position of physical evidence (broken glass, auto parts or debris, oil spills, bloodstains etc.) at the scene, and evaluating vehicle damage and other evidence.

If we have the question about how the vehicle moved before contact, usually additional data is necessary to reconstruct these circumstances, because there is no actual data describing the parameters of the vehicle's movement before the collision. This happens because vehicles are equipped with modern auxiliary systems such as anti-lock braking system, stability control, traction control system, which prevent the wheels of the car from sliding on the road surface and forming marks and traces that determine the trajectory and mode of the vehicle's movement. For this reason, the questions answered by making certain assumptions — for example, that the vehicles are moving at a constant speed or trajectory before the collision, without changing their mode of movement or at a constant acceleration. In a real case, the movement of vehicles is often more complicated, therefore, when solving questions related to the parameters of the approaching vehicles and the technical ability of the

drivers to avoid a traffic accident, the possibility of an error appears in this part of the investigation.

Event Data Recorders (EDR) historically voluntarily installed by many Automakers. In 2006, the EDR rule (49 CFR part 563) was accepted in the USA, which specified what mandatory data (in total 41 parameters) must be recorded by an EDR during an event, and since 2012, all new automobiles with EDRs had to match the specified requirements in the US. European car manufacturers that install EDRs in their cars often comply with these requirements. EDR devices were optional for European manufacturers. However, according to the new rules of the European Union, from mid-2022 all newly developed automobiles must have EDRs (categories M1 and N1); from mid 2024 – all newly registered. M2, N2, M3, N3 categories: from mid-2026 – all newly created, from mid-2029 – all newly registered.

Crash Data Retrieval equipment is used by Forensic Science Centre of Lithuania since 2016. During this time, approximately 45 investigations were concluded.

Among the most important data for the investigation is the speed of the vehicle before the collision, its trajectory and mode of movement. Provided below in table 1 is an example from the EDR report of BMW, time from -5 sec before the collision to 0 sec – the moment of the collision.

Table 1.

EDR data time — speed

<i>t</i> , sec	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0
<i>v_a</i> , km/h	146	134	119	107	92	83	87	91	82	74	66

If we do not have an EDR data and the only data available is the speed of the vehicle at the time of collision – 66 km/h, assuming that the speed of the vehicle was the same for the entire 5 second interval, the distance traveled with this speed is calculated:

$$S_a = \frac{v_a \cdot t}{3.6} = \frac{66 \cdot 5}{3.6} = 91.7 \text{ m.}$$

In a real situation, after calculating the real distance covered by the vehicle during the 5 seconds before collision, according to the data in table 1, we can determine the distance where a dangerous situation occurred and the vehicle's driver must immediately brake to avoid a collision (see table 2).

Table 2.

*Travel distance S according to *v_a* and *t**

<i>t</i> , sec	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0
<i>v_a</i> , km/h	146	134	119	107	92	83	87	91	82	74	66
<i>S</i> , m	0	19.4	37.0	52.7	66.5	78.6	90.5	102.9	114.9	125.7	135.4

From results provided in table 2, we find that the whole distance covered in 5 seconds by the car according to the actual speed values (135.4 m) is significantly higher than the calculated distance (91.7 m), assuming that the car moved at a constant collision speed for a period of 5 seconds. Such a large difference between the real distance and the distance traveled at a constant collision speed in later stages of the investigation may affect the reliability of the conclusions regarding the technical possibility of a driver to avoid collision. Thus, this example shows how important it is to have reliable data about the movement of the vehicle before the accident.

Besides the vehicle speed data, the automobile EDR report contains data on the time of the event the angle of the steering wheel, the position of the brake pedal, the fluid pressure in the brake system, the value of longitudinal and lateral delta-V speeds, acceleration values during collision, data on the SRS air bags deployments and many other parameters useful for research.

It is important to know that this data recorded during a traffic accident, when vehicle systems are overloaded and vehicle equipment breaks. The data collected at the place of the traffic accident can be used to compare with the report data in order to interpret it correctly and avoid errors. Sometimes an EDR device contains data from several events, therefore it is important to be able to identify the correct data of a specific event and use it properly.

In the future this practice of retrieving and using data in traffic accident investigations will undoubtedly expand, EDR devices will be found not only in cars, but also in trucks, buses and motorcycles, so it is very useful for experts to learn how to work with equipment that can read data from vehicle EDR devices and use them properly in accident investigations. The reliability of this data is confirmed by tests and guaranteed by automobile manufacturers who install the corresponding equipment in their vehicles.

Sex and age estimation from 2D and 3D images of bones using deep learning techniques

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Deep neural networks to accurately estimate sex from photographs of the ilium (children) and the humerus (adults), and age from 3D models of the pubic symphysis.

Keywords: forensic anthropology; biological profile estimation; age estimation; sex estimation; artificial intelligence; deep learning.

Оцінка статі та віку за двовимірними та тривимірними зображеннями кісток із застосуванням методів глибинного навчання

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Представлено глибокі нейронні мережі для точної оцінки статі за фотографіями крила клубової кістки (дітей) і плечової кістки (дорослих), а також віку за 3D-моделями лобкового симфізу.

Ключові слова: судова антропологія; оцінка біологічного профілю; вікова оцінка; оцінка статі; штучний інтелект; глибинне навчання.

Traditionally, sex estimation is performed by means of numerical/tabular data obtained from manual measurement of the bones of interest. However, the success of a set of Artificial Intelligence techniques, known as Deep Learning (DL) [1], in image

analysis problems (mainly through convolutional networks) invites the use of such techniques in the estimation of the biological profile (BP). These techniques allow fully automatic estimation from the images themselves, decreasing times and