Integration of Virtual Reconstruction into Criminal Procedure in Ukraine (Based on Example of Investigative Experiment)

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This article purpose is to conduct a comparative legal analysis of reconstruction institution of criminal offenses and to scientifically justify feasibility of introducing virtual situational investigative experiments into Ukrainian criminal proceedings as a new standard of scientific reliability and metric accuracy of evidence. For achieving this goal, general scientific and special methods of scientific cognition were used (comparative legal one, formal legal one, forecasting, modeling, systemic-structural, analysis, and synthesis). The issue of limitations of conducting traditional crime scene reconstructions in conditions of martial law, caused by the destruction of the material environment and dangerous access to the scenes of events, has been highlighted. The advantages of 3D technologies (LiDAR, photogrammetry) for creating metrically accurate digital models of the scene of the incident, which ensure the transition from subjective perception to algorithmic verification, are substantiated. The feasibility of using 3D models as an addition to investigative action protocol is proven. It is concluded that digital transformation

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of evidence is a leading stage in modernization of justice, combining technical accuracy with procedural fairness.

Keywords: *criminal proceedings; investigative experiment; virtual reconstruction; VSIE; 3D modeling; digital evidence; martial law; criminal proceedings; evidence.*

Research Problem Formulation

In modern criminal proceedings, investigative experiments are not only procedural actions, but complex cognitive tools for reconstructing the circumstances of a crime. Their evidentiary value is based on recreating conditions that are as close as possible to the original ones that makes possible to verify the reliability of testimony and clarify spatial relationships and the chronological sequence of events. At the same time, traditional forms of this action are increasingly demonstrating their limitations, namely impossibility of completely recreating situation, subjectivity of the participants' perceptions and difficulties of accurate documentation.

In particular, under martial law, law enforcement practice has encountered a number of problems related to conducting investigative experiments, reconstructing the circumstances of events, investigating the actions of those involved and analyzing the scene of events. These issues are caused by inability to access the incident scene that is located in a temporarily occupied territory; significant damage, destruction, or elimination of material evidence as a result of shelling; dangerous conditions for participants in criminal proceedings; the fact that persons whose testimony is subject to verification are located at a considerable distance from the scene of the incident or the pre-trial investigation body; the need to comply with restrictions, in particular curfews, etc. [1] One possible way to overcome these limitations and recreate the physical environment of the scene is to use modern information technologies during the investigative experiment to reconstruct the scene in virtual reality.

Article Purpose

Perform comparative legal analysis of reconstruction institution of events (investigative experiment) in theory and national practice, continental and common law systems, as well as scientifically substantiate the possibility of digital transformation of this tool into Ukrainian criminal proceedings through the introduction of virtual situational investigative experiments as a new method of scientific reliability and metric accuracy of evidence.

Research Methods

For achieving this goal, general scientific and special methods of scientific cognition were used. Comparative legal method facilitated the study of approaches to reconstruction during investigations within the national criminal justice system and legal systems of different countries. It made possible to identify common and distinc-

1 Чорноус Ю. Тактика слідчого експерименту за особливого режиму кримінального провадження в умовах воєнного стану. *Правоохоронна діяльність в умовах воєнного стану* : мат-ли Всеукр. наук.-практ. семінару (Івано-Франківськ, 21.10.2025). Івано-Франківськ, 2025. С. 145—149. URL: https://surl.li/qfckrh (date accessed: 09.01.2026).

tive features of investigative experiments as a means of obtaining evidence in criminal proceedings. Using the formal legal method, legal analysis was carried out of the provisions of the Criminal Procedural Code of Ukraine, which define the specifics and limits of conducting an investigative experiment. The forecasting method was useful for a reasonable prediction of the conditions for the introduction of the method of visual situational investigative experiment into law enforcement practice. Using the modeling method, the authors constructed ideal (imaginary) models for conducting a virtual investigative experiment in criminal proceedings. Systemic-structural analysis identified the main elements of the implementation of virtual reconstruction in criminal proceedings, determined their functional role and impact on the results of criminal proceedings. Combination of logical methods of analysis and synthesis contributed to the integration of the obtained results into a single system of scientific provisions, thanks to which essence, objectives, procedural and technical conditions, features of conducting and evaluating the results of a virtual situational investigative experiment were logically substantiated.

The selected methods together provided a theoretical justification for the problem under research and contributed to formulation of conclusions and practically oriented recommendations.

Analysis of Essential Researches and Publications

In Ukrainian criminal procedural doctrine and forensic science, fundamental aspects of the investigative experiment are quite deeply worked out in theoretical, procedural and tactical aspects. Legal nature of the experiment as an independent investigative (search) action designed to verify the investigative versions, evidence and mechanism of a criminal offense is characterized, and its place in the criminalistics system is determined [2]. The tactics of the investigative experiment were developed, the stages and methods of its conduct [3], procedure for attracting specialists were determined [4]. Peculiarities of

2 Маланчук П. М. Правова природа слідчого експерименту. *Правові горизонти*. 2018. № 9 (22). С. 52—55. DOI: 10.21272/legalhorizons.2018.i9.p52 (date accessed: 09.01.2026) ; Стратонов В. М. Слідчий експеримент у системі криміналістичних знань. *Науковий вісник Херсонського державного університету. Серія: Юридичні науки*. 2024. Вип. 1. С. 14—18. DOI: 10.32999/ksu2307-8049/2024-1-3 (date accessed: 09.01.2026).

3 Балицький Т. М. Слідчий експеримент в системі слідчих (розшукових) дій у кримінальному провадженні України : автореф. дис. ... канд. юрид. наук. Ірпінь, 2015. 20 с. URL: https://dspace.nlu.edu.ua/bitstream/123456789/16881/1/BALITSKY-2015.pdf (date accessed: 09.01.2026) ; Ковбаса В. Організаційно-підготовчі заходи до проведення слідчого експерименту. *Науковий вісник Дніпропетровського державного університету внутрішніх справ*. 2020. № 3. С. 174—179. DOI: 10.31733/2078-3566-2020-3-174-179 (date accessed: 09.01.2026).

4 Даніч Є. О. Використання спеціальних знань під час проведення слідчого експерименту : дис. ... канд. юрид. наук. Київ, 2018. 238 с. URL: https://elar.navs.edu.ua/server/api/core/bitstreams/025fac7a-69a3-45dc-91a5-2f227acdd6a3/content (date accessed: 09.01.2026) ; Антонюк П. Є., Антощук А. О., Пясковський В. В. та ін. Тактика проведення слідчого експерименту під час досудового розслідування : метод. рек. Київ, 2021. 68 с. URL: https://elar.navs.edu.ua/server/api/core/bitstreams/5fe00ee9-ad87-4a83-8054-6ebeb9e3b36f/content (date accessed: 09.01.2026).

crime scene reconstruction during the investigation of road accidents [5], murders [6] and other criminal offenses are investigated [7].

However, despite the high degree of theoretical and tactical development, investigative experiments, like any other investigative (search) activity, face the challenges of modern criminal proceedings, where the reliability of evidence and possibility of algorithmic verification of the data obtained are of paramount importance. It is in this context that the use of modern technologies, in particular 3D reconstruction (laser scanning and photogrammetry), becomes critically important, as they are capable of minimizing the subjectivity of perception and achieving high accuracy of reproduced parameters, conducting experiments in cyberspace, and obtaining reliable results without being at the actual scene of the incident.

Analysis of works devoted to research on the use of three-dimensional technologies in the investigation of criminal offenses indicates positive experience in their implementation during the examination of crime scenes, forensic investigations, and the training of investigators [8]. At the same time, the issue of using such technologies in the investigative experiment process has been raised in isolated publications [9], so it requires more in-depth research.

5 Вальчишин Г. І. Організаційно-тактичні особливості проведення слідчого експерименту під час розслідування дорожньо-транспортних пригод : дис. … д-ра філос. в галузі права. Дніпро, 2021. 250 с. URL: https://dduvs.edu.ua/wp-content/uploads/files/Structure/science/rada/df017/d.pdf (date accessed: 09.01.2026) ; Варлахов В., Свідерський О., Мітуневічус В. Участь спеціаліста в слідчому експерименті із дослідження обставин дорожньо-транспортної пригоди, яка відбулася в темний час. *Теорія та практика судової експертизи і криміналістики*. 2022. Вип. 3 (28). С. 109—123. DOI: 10.32353/khrife.3.2022.07 (date accessed: 09.01.2026) ; Коломієць В. В. Методика розслідування порушення правил безпеки дорожнього руху або експлуатації транспорту особами, які керують транспортними засобами : дис. … д-ра філос. в галузі права. Кропивницький, 2024. С. 117—137. URL: https://dnuvs.ukr.education/wp-content/uploads/2024/12/dysertacziya_kolomiyecz.pdf (date accessed: 09.01.2026).

6 Кунтій А. І. Тактика слідчого експерименту під час розслідування умисного вбивства, вчиненого в стані сильного душевного хвилювання. *Порівняльно-аналітичне право*. 2019. № 4. С. 393—396. URL: https://pap-journal.in.ua/wp-content/uploads/2020/08/PAP_4_2019.pdf (date accessed: 09.01.2026) ; Юхно О. О. Особливості проведення слідчого експерименту в досудовому розслідуванні вбивств, пов'язаних з насильством у сім'ї. *Pravo.ua.* 2023. № 2. С. 77—85. DOI: 10.32782/LAW.UA.2023.2.11 (date accessed: 09.01.2026).

7 Щербаковський М. Г. Слідчий експеримент при розслідуванні знищення або пошкодження майна. *Вісник Харківського національного університету внутрішніх справ.* 2023. № 2 (101). Ч. 1. С. 323—333. DOI: 10.32631/v.2023.2.29 (date accessed: 09.01.2026); Лепей М. В., Лепей О. В. Криміналістичне забезпечення проведення слідчого експерименту під час розслідування кримінальних правопорушень проти моральності. *Вісник кримінологічної асоціації України.* 2024. № 1 (31). С. 712—720. DOI: 10.32631/vca.2024.1.62 (date accessed: 09.01.2026).

8 Свобода Є. Ю., Юсупов В. В., Михальчук Т. В. Теоретичні та практичні аспекти 3D-сканування під час розслідування кримінальних правопорушень (оглядова стаття). *Європейський правничий часопис.* 2025. Вип. 6, 7. С. 202—209. DOI: 10.36919/3041-1149(Print).6-7.2025.202-209 (date accessed: 09.01.2026).

9 Коваленко А. В. Криміналістичне вчення про збирання, дослідження та використання доказів у кримінальному провадженні : монографія. Київ, 2024. 558 с. URL: https://

Main Content Presentation

For revealing subject of our research, it is advisable to first consider the legislative regulation of the reconstruction of the circumstances of a criminal offense in accordance with national legislation and the legislation of countries with continental and common law systems. Procedural regulation of this procedure has both common and distinctive signs.

Ukraine. According to Part 1 of Article 240 of the Criminal Procedure Code of Ukraine, *"in order to verify and clarify information that is relevant to establishing the circumstances of a criminal offense, investigator or prosecutor has the right to conduct an investigative experiment by recreating the actions, situation, and circumstances of a particular event, and conducting the necessary experiments or tests*" [10]. In essence and in terms of its objectives, an investigative experiment can take the form of two different types of investigative (search) actions, which differ in terms of the grounds for conducting them, the nature of their preparation, tactical techniques, and rules of implementation. Violation of these rules may lead to distortion of the results obtained and affect their assessment by the investigator, prosecutor, or court.

These actions include, first, investigative experiment itself (establishing the possibility of perceiving a certain fact (visibility, audibility, etc.) under certain conditions or by a specific person, performing certain actions under specific conditions or by a specific person, the existence of a certain fact and/or phenomenon under certain circumstances, as well as the mechanism of the event as a whole or its individual stages), and secondly, verification (reproduction) of previously given testimony by a person, which is carried out exclusively in the place referred to in the relevant testimony [11]. Both of these types belong to the group of investigative (search) actions that functional purpose is to verify the factual data established while criminal proceedings.

Peculiarity of investigative experiment lies in the fact that during its conduct, both people and the physical environment are sources of criminally significant information. Factual data is obtained not only through the personal perception of objects and events by the subject of the investigation, but with the help of a wide range of technical, forensic, and other technical means. The purpose of investigative experiment, as specified in the procedural norm, is implemented in numerous and varied types of such experiments developed in criminalistics [12].

Thus, one type of investigative experiment is to verify the testimony of an

rep.dnuvs.ukr.education/server/api/core/bitstreams/4bd5ad6e-849f-43ba-9772-3023b1d75509/content (date accessed: 19.01.2026) ; Павлюк Н. В. Застосування 3D-моделювання під час допиту та слідчого експерименту. *Інноваційні методи та цифрові технології в криміналістиці, судовій експертизі та юридичній практиці* : мат-ли міжнар. «кругл. столу» (Харків, 12.12.2019). Харків, 2019. С. 112—115. URL: https://surl.lt/hvpxah (date accessed: 19.01.2026).

10 Кримінальний процесуальний кодекс України від 13.04.2012 р. № 4651-VI (зі змін. та допов.). URL: https://zakon.rada.gov.ua/laws/show/4651-17#Text (date accessed: 09.01.2026).

11 Криміналістика : підручник. У 2 т. Т. 1 / за заг. ред. А. Ф. Волобуєва, Р. Л. Степанюка, В. О. Малярової. Харків, 2018. С. 243—344. URL: https://fpk.in.ua/images/biblioteka/4bac_pravo/Kryminalistyka_Pidruchnyk_Tom-1_Kharkiv_2018.pdf (date accessed: 19.01.2026).

12 Антонюк П. Є., Антощук А. О., Пясковський В. В. та ін. Зазнач. твір. С. 8. URL: https://elar.navs.edu.ua/server/api/core/bitstreams/5fe00ee9-ad87-4a83-8054-6ebeb9e3b36f/content (date accessed: 09.01.2026).

interrogated person about certain actions they performed at the scene of the incident [13]. The purpose of such an experiment is to ascertain the participant's knowledge of the location, layout, and characteristics of physical environment of the scene of the incident; to clarify the route taken to and from the scene of the incident; to establish the reliability of the testimony by comparing it with the person's actions in the physical environment and the traces of the crime recorded in the scene inspection report, etc. Such an investigative experiment is conducted directly at the scene of the incident by giving the initiative to the participant whose testimony is being verified, and its distinctive feature is that the results obtained are obvious to all persons present, in particular witnesses, without specific expertise use.

Countries of European (continental) law. Legal systems of Romania [14], Poland [15], the Czech Republic [16], Kazakhstan [17], Moldova [18] and other countries of the former socialist bloc have retained in their criminal procedure the institution of investigative experimentation in its classical sense as an independent investigative action aimed at verifying and clarifying factual data by recreating event circumstances. Despite the existence in the criminal procedure of some post-Soviet countries (in particular, Czech Republic, Kazakhstan, and Moldova) of two separate investigative actions: crime scene reconstruction and verification (or reconstruction) of testimony at the scene; this does not change their common epistemological essence as means of empirical verification of factual data, which stems from the Soviet criminalistic tradition.

On the other hand, developed European systems, in particular those of France, Germany, and Switzerland, do not contain direct regulatory provisions for an equivalent of investigative experiments, but there are forms that have an identical cognitive function. Thus, Article 81 of the French Code of Criminal Procedure, despite the absence of a normative definition of reconstruction, provides that the investigating judge shall take all measures he or she deems useful for establishing the truth, and Article 92 provides for *transport sur les lieux*: visit to the scene of the incident for observation [19]. In practice, *reconstitution* is a combination of several procedural acts,

13 Велика українська юридична енциклопедія: у 20 т. Т. 20 : Криміналістика, судова експертиза, юридична психологія / редкол.: В. Ю. Шепітько та ін. Харків, 2018. С. 583.

14 Codul de procedură penală din 1 iulie 2010 (Legea nr. 135/2010). Data intrării în vigoare: 01.02.2014. Art. 193—195. București: Ministerul Justiției / Portal Legislativ : web. URL: https://legislatie.just.ro/public/detaliidocument/120611 (date accessed: 09.01.2026).

15 Kodeks postępowania karnego : ustawa z dnia 6 czerwca 1997 r. Dz.U. 1997 nr 89 poz. 555 z późn. zm. Art. 211, 212 / ISAP : web. URL: https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU19970890555 (date accessed: 09.01.2026).

16 Zákon č. 141/1961 Sb. Zákon o trestním řízení soudním (trestní řád). Stav k 01.01.2025. § 104d, § 104e. Zákony pro lidi : web. URL: https://www.zakonyprolidi.cz/cs/1961-141 (date accessed: 09.01.2026).

17 Қазақстан Республикасының Қылмыстық-процестік кодексі : 2014 жылғы 4 шілдедегі № 231-V ҚРЗ / Әділет : web. URL: https://adilet.zan.kz/kaz/docs/K1400000231 (date accessed: 09.01.2026).

18 Codul de procedură penală al Republicii Moldova : Cod Nr. 122-XV din 14-03-2003. Art. 122 / Legis : web. URL: https://www.legis.md/cautare/getResults?doc_id=120596&lang=ro (date accessed: 09.01.2026).

19 Code de procédure pénale / Légifrance : web. URL: https://www.legifrance.gouv.fr/codes/texte_lc/LEGITEXT000006071154 (date accessed: 09.01.2026)

inspection, interrogation, demonstration, and expert examination, united by the common goal of recreating the mechanism of the event. In French criminalistics, such reconstruction is considered a synthetic procedure that combines empirical accuracy with judicial control [20].

Criminal Procedure Code of Federal Republic of Germany does not contain the concept of *investigative experiment* in the narrow sense. Judicial practice is based on the fact that experiments (in German: *versuche*) are not independent types of evidence, but may be an element of an expert conclusion or a component of an inspection of the scene of the incident [21]. Thus, German model is based on the principle of functional unity of evidentiary actions what matters is not how the action is classified, but whether the general guarantees of reliability, relevance, and verifiability are observed.

According to Article 193 of the Swiss Criminal Procedure Code, an inspection of the scene of the crime may be combined with a reconstruction or an interrogation (in French: *reconstitution des faits ou avec une confrontation*). In this case, the accused, witnesses, and other persons summoned to court are involved in the inspection [22].

Common law countries. In common law countries (US, Canada, UK, Australia), the admissibility of investigative experiments is traditionally considered through the prism of the substantial similarity test. According to this principle, the experimental conditions must be similar to the real situation, although it does not require identical conditions, but a certain similarity to ensure that the results of the experiment are relevant and reliable for the case under investigation. Thus, in the United States, the Alaska Supreme Court in *Love v. State of Alaska* formulated a requirement to demonstrate substantial similarity between the conditions of the experiment and the actual circumstances of the event, while emphasizing that absolute identity is not necessary [23].

In law enforcement, the reconstruction of events is gradually shifting from physical (objective) to digital modeling. 3D technologies, which include 3D scanning [24], photogrammetry, *additional reality* (AR) and *virtual reality* (VR), make it possible to create interactive, metrically accurate models of the scene of an incident. Not only do they replace traditional physical experiments in many cases, but they also

20 Hazan R., Cassuto Th. La reconstitution en procédure pénale. Intérêts et principes généraux. *Experts.* 2009. No. 86, Oct. Pp. 4–9. URL: https://cejpcar.org/wp-content/uploads/2015/10/RE_PUB_86-Hazan-Cassuto.pdf (date accessed: 09.01.2026).

21 Bundesgerichtshof Urt. V. 20.06.1961, Az.: 1 StR 212/61. Beweisrecht der Strafprozeßordnung (StPO). Experimente und Versuche als besondere Beweisarten / Wolters Kluwer Online : web. URL: https://research.wolterskluwer-online.de/document/8b9f76f1-037c-4edf-983c-a0debb8e2029 (date accessed: 09.01.2026).

22 Code de procédure pénale suisse du 5 octobre 2007 (État le 1er avril 2025). Art. 193 / Fedlex : web. URL: https://www.fedlex.admin.ch/eli/cc/2010/267/fr (date accessed: 09.01.2026).

23 Substantial Similarity in Conditions for Experimental Evidence: Supreme Court of Alaska's Decision in Love v. State of Alaska / Casemine : web. URL: https://www.casemine.com/commentary/us/substantial-similarity-in-conditions-for-experimental-evidence:-supreme-court-of-alaska's-decision-in-love-v.-state-of-alaska/view (date accessed: 01.02.2026).

24 3D technology encompasses a wide range of tools and methods for creating, displaying or reproducing objects in three dimensions: width, height and depth.

provide a whole new level of metric accuracy and objectivity of evidence [25].

In *British* practice, 3D reconstruction is actively used in investigations of traffic accidents, murders, and terrorist attacks, and the results of VR reconstructions are accepted by courts as supporting evidence, provided that their reliability is confirmed by experts [26]. According to *Ch. Villa, N. Lynnerup,* and *Ch. Jacobsen*, use of a multimodal 3D approach makes it possible to create a single interactive database where the topography of the scene, the victim's body, and material evidence are coordinated in a single digital environment [27]. This creates a new type of virtual investigative experiment that takes place in cyberspace but retains procedural guarantees of reliability.

In US judicial practice, virtual models can be integrated into court proceedings as evidence if they are relevant to the case and there are no grounds for exclusion (in accordance with Rules: 401 "*Test for Relevant Evidence*," 402 "*General Admissibility of Relevant Evidence*," 403 "*Exclusionary Rule*" *Federal Rules of Evidence* [28]), and meet the standards of scientific reliability defined in the case of *Daubert v. Merrell Dow Pharmaceuticals* (1993) [29].

In their fundamental analysis of numerous literary sources highlighting the problems of applying tools, technologies, methods, and techniques of 3D crime scene reconstruction, *M. A. Maneli and O. E. Isafiade* note that traditional means of recording information from the scene of the crime do not achieve or maintain the necessary integrity of information about the crime, while 3D crime reconstruction using immersive reality technologies provides a reproduction of the scene with an accuracy of several millimeters and allows various hypotheses to be tested in real time [30].

Thus, analysis of foreign legal systems shows that although the concept of investigative experiment as an independent procedural form is unique to Ukrainian (and more broadly, post-Soviet) law, actions similar in their functional purpose exist in most legal systems.

Epistemological standards of reliability. During pre-trial investigations, conducting investigative experiments under martial law often encounters significant difficulties: the scene of the incident may be located in occupied territory, and if it is in a frontline zone, it may be destroyed or significantly damaged, making it dangerous for participants in criminal proceedings to be there, and some of them (victims, witnesses) are located far from both the

25 Flor N. V. Technology Corner: Virtual Crime Scene Reconstruction: The Basics of 3D Modeling. *Journal of Digital Forensics, Security and Law*. 2011. Vol. 6. N. 4. Art. 6. DOI: 10.15394/jdfsl.2011.1108 (date accessed: 09.01.2026).

26 Forensic Crime Scene Reconstruction, Virtual Reality / NCAVF : web. 2018. URL: https://ncavf.com/what-we-do/crime-scene-reconstruction/ (date accessed: 09.01.2026).

27 Villa Ch., Lynnerup N., Jacobsen Ch. A Virtual, 3D Multimodal Approach to Victim and Crime Scene Reconstruction. *Diagnostics*. 2023. Art. 13(17):2764. DOI: 10.3390/diagnostics13172764 (date accessed: 09.01.2026).

28 Federal Rules of Evidence (amended to Dec 1, 2024) / Cornell Law School. LII : web. URL: https://www.law.cornell.edu/rules/fre (date accessed: 02.02.2026).

29 Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U. S. 579 (1993) / Justia U. S. Supreme Court : web. URL: https://supreme.justia.com/cases/federal/us/509/579/ (date accessed: 09.01.2026).

30 Maneli M. A., Isafiade O. E. 3D Forensic Crime Scene Reconstruction involving Immersive Technology: A Systematic Literature Revie. *Institute of Electrical and Electronics Engineers (IEEE) Access*. 2022. Vol. 10. Pp. 1–51. DOI: 10.1109/access.2022.3199437 (date accessed: 09.01.2026).

scene of the incident and the investigating authority. All this makes it impossible to carry out investigative actions in the traditional form. At the same time, the current level of development of science and technology makes it possible to solve this problem with the help of 3D technologies.

Because of 3D scanning followed by 3D reconstruction of a criminally relevant object, it is possible to create a digital 3D model that reflects the linear and spatial characteristics of such an object, the relative positioning of elements of its external structure, color, and other signs [31]. Creation of 3D models of criminal offense scene in cases where access to it is difficult, impossible, or dangerous can be considered a type of complete reconstruction of the scene, which is recommended while conducting investigative experiment [32].

The use of 3D reconstruction of the crime scene is in line with the latest trend of gradual digitization of the evidence process, where circumstances of the crime are recreated using virtual reality immersion technologies. According to O. Dufeniuk, this not only creates an objective need for a modern procedural tool, but also provides a basis for improving the process of documenting the scene of the crime, signals the emergence of a new generation of technical and forensic tools, and a new comprehensive field of forensic science: three-dimensional criminalistics [33].

Therefore, it can be argued that 3D reconstruction of the scene of the crime during criminal proceedings opens up the following areas of application:

1) conducting a remote crime scene reconstruction at the scene of the incident (virtual crime scene reconstruction);
2) creation of 3D models of objects (weapons, burglary tools, etc.) that are printed on a 3D printer and serve as real prototypes;
3) output material for further expert investigation;
4) visual presentation of the scene of the incident and the results of the investigative experiment for the court [34].

It proves that high-precision reconstruction of events cannot completely replace investigative experiments in the "classical" sense, nor can it become a component of expert examination or inspection: such reconstruction requires a unique hybrid status. That is why we propose a new concept that involves recreating the circumstances of a criminally relevant event not in a real location, but in a virtual 3D environment: *Virtual Situational Investigative Experiment* (VSIE). Its purpose is to verify testimony and investigative versions, analyze the mechanism of the event, and obtain evidence using information technology.

31 Коваленко А. В. Зазнач. твір. С. 201. URL: https://rep.dnuvs.ukr.education/server/api/core/bitstreams/4bd5ad6e-849f-43ba-9772-3023b1d75509/content (date accessed: 02.02.2026).

32 Негребецький В. Криміналістична реконструкція як тактичний прийом слідчого експерименту. *Підприємництво, господарство і право.* 2019. № 6. С. 318. DOI: 10.32849/2663-5313/2019.6.59 (date accessed: 09.01.2026).

33 Дуфенюк О. М. Майбутнє 3D криміналістики: інновації, які змінюють практику досудового розслідування. *Юридичний науковий електронний журнал.* 2024. № 3. С. 458. DOI: 10.32782/2524-0374/2024-3/110 (date accessed: 09.01.2026).

34 Carew R. M., French J., Morgan R. M. 3D Forensic science: A new field integrating 3D imaging and 3D printing in crime reconstruction. *Forensic Science International: Synergy.* 2021. Vol. 3. Art. 100205. P. 2. DOI: 10.1016/j.fsisyn.2021.100205 (date accessed: 19.01.2026).

A virtual investigative experiment changes not only the form of proof, but also the epistemological model of truth in the criminal process. While a traditional experiment verifies testimony through "objective" reproduction, a digital experiment uses virtual modeling based on 3D scanning, photogrammetry, video recording, and other digital measurements of spatial parameters of the scene. Thus, the criterion of reliability shifts from "subject testimony" to "algorithm reliability". However, this change shifts the focus of legal assessment to reliability (integrity) of input data (*data integrity*) and the *validity of the expert method*, requiring new legal standards for assessing such evidence. The legal community, in particular *D. Notowitz*, recognizes 3D models as admissible evidence provided that the requirements of authenticity, *reproducibility* and lack of distortions are met [35].

The most important achievement of digital reconstructions is that they combine spatial accuracy with cognitive visualization. In addition, thanks to deep immersion, virtual reality serves not only as a source of evidence, but also as an effective means of communicating complex facts to participants in legal proceedings (judges, jurors), facilitating their better cognitive perception.

Advantage of reconstructing scene of the incident using 3D modeling is that the visual nature and the ability to create animations make possible to consider different versions of the incident and identify contradictions in the testimony of the person being questioned. Thus, advantages of virtual reconstructions over traditional investigative experiments are obvious: they ensure permanent recording of evidence without the risk of losing, allow the experiment to be repeated multiple times without interfering with the physical environment, and objectively verify the witness's *line of sight* [36] or the trajectory of objects that is crucial for refuting or confirming testimony [37]. For example, demonstrating a 3D model of the scene of the crime that's been changed on purpose so that the person whose testimony is being checked can reconstruct it will help verify that person's knowledge of the crime scene. This tactic lets the person show how much they know, and lets the investigator disprove false testimony [38].

Prospects for integrating 3D technologies into *Ukrainian legislation and judicial practice*. Ukraine currently lacks a legal mechanism that would allow digital reconstructions to be officially used as independent evidence. Given the well-founded need to comply with scientific reliability standards, the most logical approach is not to amend Article 240 of Criminal Procedural Code of Ukraine, but to use 3D models of the scene of the incident as an appendix to the investigative experiment

35 Notowitz D. Using 3D Scans and Modeling as Evidence in Court. *Law Technology Today*. 2023. Nov 08. URL: https://www.americanbar.org/groups/law_practice/resources/law-technology-today/2023/using-3d-scans-and-modeling-as-evidence-in-court/ (date accessed: 19.01.2026).

36 *Line of sight*—straight path between an observer's eye and a subject, allowing visual perception of an event under specific spatial conditions.

37 Kowbuz D. How 3D scanning rebuilds crime scenes for courtrooms : Capturing crucial evidence to aid justice / Gim-international : web. 2020. May 13. URL: https://www.gim-international.com/content/article/how-3d-scanning-rebuilds-crime-scenes-for-courtrooms (date accessed: 02.02.2026).

38 Павлюк Н. В. Зазнач. твір. С. 112—115. URL: https://surl.lt/hvpxah (date accessed: 19.01.2026).

protocols (Article 105 of Criminal Procedural Code of Ukraine) [39].

In our opinion, 3D reconstruction of the scene of the incident can be used for investigative experiments in two situations. First, while verifying testimony, when a person on a virtual model shows the trajectory of their movement on the territory or inside the premises, demonstrates elements of the physical environment with which they came into contact, indicates the location of persons at the scene or the location of items relevant to the investigation, etc. In addition, during a real experiment, models of objects from the scene of the incident, made on a 3D printer, can be used. Secondly, conducting an investigative experiment to establish or refute certain objective facts, for example, location or distance between elements of the environment, as well as ability to see individual objects from a specific location, etc. It should be noted that an investigative experiment is conducted when there is no need for special knowledge to perform complex mathematical calculations or laboratory researches, that is typical for expert research [40].

The first, fundamental, and necessary condition for integrating virtual situational investigative experiments into the process of investigating criminal offenses is the implementation of forensic recommendations for 3D documentation of crime scenes [41]. There are two main methods for recording crime scenes: laser scanning and photogrammetry. During laser scanning (*LiDAR*) [42], the scanner is mounted on a tripod and emits laser beams in a 360-degree arc, recording and measuring the distance to objects. As a result, millions of points: *Point Cloud* form an accurate geometric copy of the crime scene with an error of 1–2 mm. Photogrammetry is used to create a 3D model based on a series of photographs taken from different angles (often using drones). Special software "stitches" the photographs into a three-dimensional model. Photogrammetry and laser scanning technologies make it possible to create digital copies of objects and situations that can be reproduced at any time during a pre-trial investigation or court proceedings. In addition, this will help to ensure the principle of immediacy of evidence examination by the court (Article 23 of the Criminal Procedural Code of Ukraine) [43], even if the physical location of the incident has already changed.

Another important contribution to the implementation of a virtual situational surveillance experiment in the criminal process is the procedural consolidation of standards for the authenticity and integrity of digital evidence. We will talk about the significance of their approach, the format of saving and verification methods. These standards are necessary to ensure the scientific validity of all virtual tracking experiment techniques. For

39 Кримінальний процесуальний кодекс України … . URL: https://zakon.rada.gov.ua/laws/show/4651-17#Text (date accessed: 09.01.2026).

40 Villa Ch., Lynnerup N., Jacobsen Ch. Op. cit. DOI: 10.3390/diagnostics13172764 (date accessed: 09.01.2026).

41 Баранчук В. В. 3D сканування як спосіб фіксації на місці злочину: переваги й недоліки. *Юридичний бюлетень*. 2020. Вип. 16. С. 280—286. DOI: 10.32850/LB2414-4207.2020.16.01 (date accessed: 09.01.2026).

42 *LiDAR (Light Detection and Ranging)* is a remote sensing technology that uses rapid laser pulses to measure distances and create highly accurate 3D models of environments.

43 Кримінальний процесуальний кодекс України … . URL: https://zakon.rada.gov.ua/laws/show/4651-17#Text (date accessed: 09.01.2026).

formulating national requirements, it was possible to completely speed up the use of foreign approaches, such as those developed in the United States (Rule 901 "*Authentication or Identifying Evidence*") [44] and the international standard ISO/IEC 27037:2012 [45] that is a guideline for the development of reliable methods and procedures for working with digital evidence.

The third component of proposed form integration of investigative experiment is the training of law enforcement personnel: investigators, prosecutors, judges. A virtual investigative experiment requires not only technical resources, but also a new cognitive culture of evidence. Investigators and prosecutors must have basic knowledge of proper 3D documentation of relevant investigative actions (inspection, experiment) and judges as of the correct assessment of their results.

Based on the above, we can identify the main advantages of using 3D reconstruction of the scene of the incident in an investigative experiment:

- investigative experiment transition from the category of subjective actions to the category of precise instrumental research;
- conducting investigative actions by participants in criminal proceedings in a safe environment without real risks associated with military operations;
- no restrictions on repetition and analysis;
- saving time and resources, as it does not require the organization of complex, repeated, costly visits to the incident scene;
- digitally stored images are accessible at any time, making it easier to analyze unsolved cases [46].

Conclusions

Comparative legal analysis shows that while continental systems keep the reconstruction of events within the limits of the traditional judicial form, common law countries have transformed it into a high-tech evidentiary procedure, where the criterion of reliability has shifted from subjective perception to algorithmic verification. For the Ukrainian criminal process, especially under martial law, the introduction of a virtual situational investigative experiment is not just a technical innovation, but a procedural necessity due to the impossibility of access to occupied territories or destruction of material environment.

Based on performed research, we consider it necessary to record the following conceptual provisions.

Procedural status and integration. A virtual situational investigative experiment is a type of investigative experiment, the essence of which is to recreate the circumstances, actions or situation of a criminally relevant event in an artificially created three-dimensional environment based on metrically accurate data from the digi-

44 Federal Rules of Evidence. Rule 901. Authenticating or Identifying Evidence / Cornell Law School. LII : web. URL: https://www.law.cornell.edu/rules/fre/rule_901 (date accessed: 09.01.2026).

45 ISO/IEC 27037:2012 Information technology — Security techniques — Guidelines for identification, collection, acquisition and preservation of digital evidence / ISO : web. URL: https://www.iso.org/standard/44381.html (date accessed: 09.01.2026).

46 Bricken M. Virtual Reality Learning Environments: Potentials and Challenges. *ACM Siggraph Computer Graphics*. 1991. Vol. 25. Is. 3. Pp. 179–180. DOI: 10.1145/126640.126657 (date accessed: 09.01.2026).

tization of the scene of the incident (3D scanning, photogrammetry). It should not be considered as an alternative to a traditional investigative experiment: rather, it is a digital evolution of such an investigative experiment. Optimal mechanism for legalizing 3D models is to use them as appendices to the protocol of the investigative action, which ensures the fulfillment of the requirements of Art. 240 of Criminal Procedural Code of Ukraine and at the same time implements the principle of direct examination of evidence even if the scene of the incident is physically changed.

Standards of scientific reliability. Foundation of the use of virtual reconstruction should be strict adherence to standards of authenticity and data integrity. Digital model only acquires evidentiary value when it meets the criteria of reproducibility and validity of the method, by analogy with the international standard ISO/IEC 27037:2012 and the principles of scientific reliability used in international practice.

Delimitation of competences. It is necessary to clearly distinguish the procedural role of the investigator (as a subject of knowledge) and the specialist (as a technical assistant). Use of *LiDAR* and photogrammetry technologies requires the involvement of special knowledge to create a *Point Cloud*, however, the evaluation of the obtained results and verification of the investigative versions remains the exclusive prerogative of the subject of investigation and the court.

Epistemological transition. Introduction of a virtual situational investigative experiment will mark the transition from personal testimony to a scientifically verified model of the event. This will help minimize the subjectivity of participants, secure the process, and achieve truth in a digital format that is resistant to influence of time and external circumstances.

Therefore, digital transformation of the investigative experiment through the implementation of virtual 3D reconstruction is a leading stage in the modernization of the national theory of evidence, which makes it possible to combine technical accuracy with the principles of procedural justice.

Інтеграція віртуальної реконструкції у кримінальний процес України (на прикладі слідчого експерименту)

Михайло Щербаковський,
Юрій Мирошниченко

Мета — провести порівняльно-правовий аналіз інституту реконструкції подій кримінального правопорушення та науково обґрунтувати доцільність впровадження в український кримінальний процес віртуального ситуаційного слідчого експерименту як нового стандарту наукової надійності й метричної точності доказування. Для досягнення поставленої мети застосовано загальнонаукові та спеціальні методи наукового пізнання (порівняльно-правовий, формально-юридичний, прогнозування, моделювання, системно-структурний, аналіз і синтез). Актуалізовано проблему обмеженості проведення традиційного слідчого експерименту в умовах воєнного стану, що зумовлено руйнуванням матеріальної обстановки й небезпечним доступом до місць подій. Обґрунтовано переваги 3D-технологій (LiDAR, фотограмметрія) для створення метрично точних цифрових моделей місця події, що забезпечують перехід від суб'єктивного сприйняття до алгоритмічної верифікації. Доведено доцільність використання 3D-моделей як додатка до протоколу слідчої дії. Зроблено висновок, що цифрова трансформація доказування

є провідним етапом модернізації правосуддя, що поєднує технічну точність із процесуальною справедливістю.

Ключові слова: *кримінальне провадження; слідчий експеримент; віртуальна реконструкція; VSIE; 3D-моделювання; цифрові докази; воєнний стан; кримінальний процес; доказування.*

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Declaration of Competing Interest

The authors declare no conflicts of interest relevant to this topic; although Mykhailo Shcherbakovskyi is a member of the collection advisory board, he did not participate in the decision to publish, and this article has undergone a full peer review and editing.

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