Research on Copyright Infringement in AI-Generated Works

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Abstract: The rapid evolution of generative artificial intelligence technologies has precipitated structural contradictions between their data-driven creative mechanisms and existing copyright frameworks, posing formidable challenges in determining copyright infringement for AI-generated content. This investigation centers on infringement characteristics across three critical phases—data acquisition, model training, and content generation—with empirical analysis revealing distinct patterns including traceability challenges, exponential proliferation of impacts, and chained distribution of liable entities. The conventional "access+substantial similarity" adjudication framework demonstrates inherent limitations when addressing the fragmented recombination nature of generated content, while judicial practices expose systemic deficiencies. To address challenges, the study proposes institutional innovations that encompass dynamic ownership determination protocols, the reconstruction of "substantial appropriation" criteria in originality assessment, and the refinement of fair use exemption clauses for machine learning applications, aiming to achieve synergistic integration of technological governance and legal regulation. Key findings underscore that establishing differentiated ownership allocation systems, implementing anti-plagiarism algorithm embedding technologies at the computational level, and precisely demarcating fair use boundaries constitute pivotal solutions to infringement disputes. Future research must prioritize methodological breakthroughs in infringement determination paradigms alongside advancements in intelligent detection toolkit development to navigate this evolving legal-technological frontier.

1 INTRODUCTION

With the breakthrough development of generative AI technology, intelligent creation tools like ChatGPT and Stable Diffusion have deeply integrated into traditional creative fields such as literature, art, and music. These technologies, trained on vast amounts of data and using deep learning algorithms, can independently generate text, images, and audio-visual content that appear to be original. However, the data-driven creation mechanism of these models conflicts structurally with the current copyright system: on one hand, training the models requires scraping billions of copyrighted works from the internet, potentially infringing on the rights of reproduction and adaptation; on the other hand, the fragmented recombination characteristics in the generated content pose challenges to the traditional 'access + substantial similarity' standard for determining infringement.

The academic community has established a preliminary research framework on the copyright issues of AI-generated content. Technologists focus on algorithm transparency and infringement tracing mechanisms, advocating for the use of blockchain evidence storage and text fingerprint recognition to break the 'algorithmic black box.' The legal interpretation school aims to reconstruct the standards for recognizing originality, proposing theories such as 'significant use' and 'dynamic ownership rules.' In judicial practice, courts in Beijing, Shenzhen, and other regions have attempted to establish standards for the copyrightability of AI-generated content through case judgments, but common issues include lagging infringement comparison methods and unclear standards for liability allocation. Notably, the 'machine learning exception clause' added to the EU's AI Act in 2023 and the US Copyright Office's 'AI Generated Content Registration Guidelines' mark the beginning of foreign legislation addressing technical challenges. However, these systems need to be adapted to China's legal system to ensure compatibility. This article focuses on the challenges of copyright infringement in the entire lifecycle of generative artificial intelligence, delving into the

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legal risks associated with data collection, model training, and content output. By analyzing the technical mechanisms of AI creation and judicial precedents, it highlights the systemic failures of existing legal rules in addressing new forms of infringement, such as fragmented recombination, algorithmic black boxes, and distributed responsibility chains.

The study aims to develop a framework for identifying infringement that aligns with the characteristics of technology, proposing institutional solutions that include dynamic ownership allocation, significant use determination, and the restructuring of fair use exemptions. It seeks to address the evidentiary challenges posed by the 'technological invisibility' and the ineffectiveness of remedies due to the aggregation of minor infringements, providing theoretical support and practical pathways for the adaptive transformation of copyright systems in the age of artificial intelligence.

2 ORIGINS AND LEGAL CHARACTERISTICS OF COPYRIGHT INFRINGEMENT IN AI-GENERATED WORKS

The infringement issues surrounding AI-generated works stem from systemic misalignment between their technical mechanics and current copyright frameworks. Technologically, the creative process of generative AI is divided into three distinct phases: data ingestion, algorithmic training, and content output, each carrying prima facie copyright infringement implications.

2.1 Source of Infringement Issues

2.1.1 Data Input

During the data ingestion phase, generative AI systems construct training datasets by scraping massive volumes of internet-based texts, images, and audiovisual materials—a process potentially involving unlawful reproduction of copyrighted works. For instance, Microsoft's AI poetry collection Sunshine Lost the Glass Window was created through algorithmic analysis of tens of thousands of modern poems; the incorporation of unlicensed works in such training data constitutes direct copyright infringement. The automated and concealed nature of this data acquisition creates a double-threat scenario: rights holders rarely detect inclusion of their works in training corpora, causing large-scale infringement that often remains undetected for prolonged periods.

2.1.2 Algorithm Training

Infringement risks during the algorithmic training phase predominantly concern derivative work rights. Generative AI systems employ neural network models to extract stylistic features and reconstruct patterns from training data, a process potentially constituting unauthorized adaptation or translation of original works. In Authors Guild v. OpenAI, plaintiffs alleged that ChatGPT disassembled the Harry Potter novels into textual shards for model training without authorization, subsequently generating text mimicking the series' narrative conventions, thereby implicating adaptation right violations (American Writers Association, 2023). The infringement risks during the algorithm training phase primarily focus on the right of adaptation. Generative AI uses neural network models to extract features and reconstruct patterns from training data, which can potentially constitute adaptation or translation of the original work. In the case of the American Authors Association v. OpenAI, the plaintiffs accused ChatGPT of using the 'Harry Potter' series without authorization, breaking it down into text segments for model training, and generating similar narrative styles through algorithms, thereby infringing on the right of adaptation (American Writers Association, 2023). The unique aspect of such infringements is that the algorithm's use of the work transcends the traditional' word-for-word replication 'model, instead achieving style imitation through semantic parsing. This shift in infringement determination requires a focus on' creativity logic convergence 'rather than' similarity in expression,' significantly increasing the complexity of judicial decisions.

2.1.3 Content Output

Infringement during the content output phase primarily manifests as substantial similarity between the generated work and existing works. In 2023, the Beijing Internet Court heard the 'first AI painting infringement case,' where the defendant used the Stable Diffusion model to create a painting titled 'Digital Dunhuang.' This painting closely matched the core elements of Li's meticulous and colorful work in terms of composition and color coordination. The court ruled that the generated work was substantially similar and ordered the defendant to bear (Beijing Internet Court AI Painting Infringement Case, 2023). These cases highlight new features of AI-generated

content infringement: first, the infringing content exhibits a' fragmented recombination 'characteristic, where the generated work may incorporate elements from multiple works without directly copying any single one; second, the infringing entities show a' chain-like' trend, with developers, platform operators, and end users all potentially liable. For instance, developers are responsible for selecting data sources and designing algorithms, platforms are responsible for monitoring during the release process, and users can also produce illegal outputs at the input stage. All parties must be held accountable based on their respective degrees of fault.

2.2 Feature

The core characteristics of generative AI infringement are primarily reflected in the 'untraceability' of the infringement. The unexplainable nature of deep learning models makes it difficult to trace the infringement process, leaving one unable to determine which specific works were used as training data or to prove a causal link between the generated content and specific works. Secondly, the consequences of infringement are characterized by 'large-scale diffusion.' According to OpenAI, ChatGPT has over 180 million monthly active users, and a single infringing model can generate millions of infringing pieces of content in a short time, far exceeding the scope of traditional human-generated infringement. Lastly, the determination of responsibility is marked by 'diversity and complexity,' as factors such as whether developers fulfill data filtering obligations, whether platforms establish infringement warning mechanisms, and whether users have malicious intent must all be considered in liability assessment. There is an urgent need to establish a 'technology + law' collaborative governance framework.

3 JURISPRUDENTIAL DILEMMAS IN INFRINGEMENT DETERMINATION FOR AI-GENERATED WORKS

The copyright infringement disputes arising from AI-generated content in judicial practice highlight a structural conflict between legal rules and technological features. The 'access + substantial similarity' standard, commonly used in current judicial practices, faces significant challenges when dealing with generative AI works. In the 2023 case of Tencent v. Yingxun Technology, the Nanshan District People's Court of Shenzhen ruled that the financial report in question was a literary work, but the court still used traditional methods for infringement comparison, failing to adequately consider the data aggregation characteristics of AI-generated works (Tencent v. Yingxun Technology, 2019). This judicial dilemma reflects the comprehensive impact of generative AI technology on the existing copyright legal system, specifically manifested in three issues: ambiguous standards for infringement determination, difficulties in identifying responsible parties, and ineffective mechanisms for rights relief.

3.1 The Standard of Infringement Identification Is Vague

In the context of identifying infringement, the traditional 'substantial similarity' standard is not effectively applicable to AI-generated content. Generative AI uses neural network models to extract features and reorganize patterns from vast amounts of data, resulting in output that often exhibits fragmented borrowing characteristics. For instance, the text generated by ChatGPT may involve a minute use of tens of thousands of works, with each segment having a similarity below the threshold for fair use, yet the overall combination results in a substantial replacement of the original work. This gradual data utilization method places current infringement identification rules in an awkward position. If judicial authorities mechanically apply the 'word-by-word comparison' method, it could result in large-scale hidden infringements escaping legal regulation. In the case of the American Authors Association v. OpenAI, the plaintiff accused ChatGPT of illegally copying 1.76 million books during its training, but the defendant argued for 'transformative use.' The focus of the dispute in this case highlights the challenge of aligning traditional infringement identification standards with the characteristics of machine learning (American Writers Association, 2023).

3.2 Difficulty in Determining the Subject of Responsibility

The definition of liability subjects in tort has become a 'trouble' in judicial practice. The generative AI industry chain involves multiple parties, including data collectors, algorithm developers, model trainers, platform operators, and end users, forming a complex liability network. Bu Lingjie's three-stage theory of

generative AI operation suggests that the risk of infringement during the data acquisition stage should primarily be borne by the developers, while the liability for infringement during the output stage may involve the users (Bo, 2023). In the 2023 AI painting infringement case heard by the Beijing Internet Court, the defendant argued that they only inputted the keyword' cyberpunk style, 'and the image generation was entirely autonomous, leading to the court ultimately ruling that the platform operator should bear responsibility based on the principle of' necessary arrangements' (Beijing Internet Court AI Painting Infringement Case, 2023). While this judicial approach is innovative, it has not yet formed a unified standard. Ren Le et al. emphasize the need to establish a dynamic attribution system in multi-party scenarios, allocating responsibility based on technical control and degree of fault (Ren, 2023).

3.3 Failure of Rights Relief Mechanism

The rights protection mechanism faces the dual challenges of technical failures and institutional barriers. The 'untraceable' nature of generative AI makes it extremely difficult to gather evidence of infringement, as struggles to trace the specific sources of the model training data. Even if an infringement is identified in the output content, tracing the source still requires deciphering complex algorithm models and data processing paths, posing a significant challenge to traditional evidence-gathering methods. More importantly, the cumulative effect of minor infringements can lead to an imbalance between the costs and benefits of litigation for right holders, reducing their motivation to pursue legal action. The U.S. class-action lawsuit case, 'New York Times v. Microsoft,' highlights that when infringement is widespread among millions of users with minimal damage per incident, the current litigation system struggles to effectively aggregate relief (The New York Times v. Microsoft, 2023).

4 REGULATORY FRAMEWORKS FOR INFRINGEMENT DETERMINATION OF AI-GENERATED WORKS

In judicial practice, for instance, the Nanshan District People's Court of Shenzhen confirmed in its civil judgment (2019) Yue 0305 Min Chu 14010 that AI-generated content can be copyrighted, but it failed to address the fundamental issues of vague standards for infringement determination and the diversification of responsible parties (Tencent v. Yingxun Technology, 2019). The institutional limitations in recognizing AI-generated content as infringing stem from the conflict between traditional copyright rules and new technological forms. In the current era where generative AI, such as ChatGPT, is deeply integrated into creative fields, it is necessary to reconstruct the infringement determination rule system from three dimensions: ownership allocation, originality standards, and the boundaries of fair use, to achieve an organic combination of technological innovation and rights protection.

4.1 Establish Dynamic Rules of Ownership Identification to Clarify the Basis of Responsibility

The layered contributions of designers, trainers, and users in the generative AI creation process have led to the traditional 'creativity-based' ownership rules becoming ineffective. Zhou Hang's' dynamic system theory 'offers a solution: ownership recognition rules should be established based on technical involvement and interest relevance (Zhou, 2022). In autonomous generation scenarios, if users significantly influence content output through command fine-tuning and parameter settings, copyright should be attributed to the user, following the rules for commissioned works. In procedural generation scenarios, where the output is entirely dependent on preset algorithms and lacks human intervention, rights can be allocated to developers or investors, drawing on the legal framework for corporate works. This tiered recognition mechanism not only reflects the' human-centric 'foundation of copyright law but also provides a clear institutional anchor for future infringement liability. Additionally, judicial practice should establish a necessary creative contribution review standard, focusing on the substantial input of all parties in data cleaning, feature extraction, and style shaping. For instance, in the' Tencent Dreamwriter case, 'the court identified the user's key elements of original expression in the financial report's framework design by analyzing manual interventions such as data screening rule settings and corpus feature labelling (Tencent Dreamwriter Case, 2019). This transparent review method, which makes technology' untraceable, 'offers a viable solution to the' human-machine confusion' dilemma in generative AI creation.

4.2 Restructuring the Identification Standard of Originality to Define the Boundary of Protection

The 'probabilistic generation' mechanism of generative AI has introduced a new issue distinct from traditional copyright infringement: the determination of work similarity has fallen into a 'fragmented infringement' scenario. Given that the traditional 'access + substantial similarity' rule struggles to address minor usage in vast amounts of training data, the 'blurred originality standard' highlighted by Wu Handong is particularly evident (Wu, 2023). It is recommended to introduce the 'significant use' standard, which can be seen as an extension and refinement of the traditional 'similarity of main expressive elements' standard. This standard emphasizes whether the AI reproduces the 'creative core' of the original work in the context of vast amounts of training data. It evaluates the extent to which the accused infringing work utilizes the original work from both qualitative and quantitative perspectives. If the expressive elements extracted from the AI-generated content constitute the core creative features of the original work or if the cumulative usage exceeds the industry standard threshold, it can be presumed that there is substantial similarity. Additionally, a 'traceable creation process' mechanism should be established, requiring developers to maintain logs of the source data and feature extraction records, providing technical support to address the evidence challenges posed by the 'algorithmic black box.' In setting the originality threshold, it is crucial to be cautious of the risk of 'ultra-low originality standards' leading to the overgeneralization of rights. Wang Qian emphasized that merely 'unforeseen combinations by humans' is insufficient to determine originality; it must be assessed whether the output content reflects personalized choices and aesthetic judgments (Wang, 2022). For texts, images, and other content generated entirely through model iteration, the creative height should be raised to prevent mechanical outputs from being included in copyright protection. This "step-by-step originality" identification model aims to set the different levels of human creation as the basis for hierarchical judgment, and effectively avoid the inclusion of non-creative data output into copyright protection. This not only meets the essential requirements of "intellectual creation" in the Berne Convention, but also avoids inhibiting artificial intelligence technology innovation.

4.3 Improve the Reasonable Use System to Balance the Interests of Various Parties

The massive data acquisition used in the training phase of generative AI poses a potential risk of copyright infringement. To address this risk, the 'Text and Data Mining Exception' established in Article 4 of the EU's Digital Single Market Copyright Directive is worth considering. Li Yang's research shows that this rule achieves an effective balance between rights limitation and technological innovation by limiting the purpose of use and technical measures (Li, 2023). It is suggested to add a 'Machine Learning Exception' to Article 24 of China's Copyright Law, allowing developers to copy and analyze publicly available works to improve algorithm performance, provided that three conditions are met: the source of training data is legal, the use does not substantially replace the original market, and a rights holder exit mechanism is established. This exception clause can resolve the' legality crisis of data acquisition 'and prevent' technological neutrality 'from becoming an excuse for infringement. To prevent infringement at the output end, a dual governance mechanism of' technology + law 'should be established. Jiao Heping's proposal of the 'obligation to embed anti-plagiarism algorithms' is of significant reference value, requiring developers to incorporate technical measures such as content similarity detection and digital watermark recognition into their model designs (Jiao, 2022). When users use generative AI to engage in 'rewriting' and 'borrowing ideas' to circumvent regulations, the platform's liability can be pursued under Article 1197 of the Civil Code. This collaborative governance model not only meets the technical ethics requirements outlined in Article 4 of the Interim Measures for the Administration of Generative AI Services but also provides a comprehensive remedy for rights holders.

5 EMERGING PARADIGMS RESHAPING SCHOLARLY INQUIRY

The academic community still has significant disagreements regarding the copyright infringement of AI-generated works, particularly in terms of infringement determination standards and defense rules. Liu Youhua and Wei Yuanshan's research indicates that AI infringement is characterized by'

minimal use, multi-source aggregation, 'making the traditional' substantial similarity 'rule difficult to apply. They recommend introducing a comprehensive fragment usage ratio 'standard, which evaluates whether the proportion of text segments used from the training set exceeds the reasonable use threshold (Liu &Wei, 2023). This standard should integrate NLP technology to deconstruct the generated text's semantics and calculate the relevance density with the training data using vector space models. For instance, if the semantic units extracted from AI-generated text overlap with specific works by more than 15%, it can be inferred that this constitutes expressive reproduction (as shown in the 2023 experiment data from UC Berkeley (University of California, 2023)).

Future theoretical advancements in the field of infringement governance should focus on two key dimensions: innovation in infringement identification rules is urgently needed, and a 'transformative use' framework suitable for AI scenarios should be developed to clearly differentiate between text mining during the training phase and commercial use during the generation phase. This framework could draw inspiration from Bu Lingjie's' four-step test, 'which focuses on assessing whether AI-generated content has created new expressions, generated new meanings, possessed new functions, or significantly replaced the original market. It is important to note that if AI merely transforms the original work, such as rewriting a novel into poetry or simply rearranging synonyms, without substantial creative arrangement, it does not meet the requirement of' new expression. 'Similarly, if AI-generated content merely repeats the plot of the original work (such as imitating the magical world of' Harry Potter ') without conveying new perspectives or metaphors through deconstruction and recombination, it is considered to have not generated' new meaning. 'When AI-generated content (such as news summaries) directly replaces users' need to read the original news report, leading to a decline in the original work's traffic or revenue, it constitutes market substitution. Additionally, the use of materials like academic papers must strictly distinguish between their use for training AI models to improve algorithm performance (technical purpose) and their output results for commercial marketing (economic purpose), to determine whether there is a substantial transformation. In terms of the technical testing system, it is necessary to accelerate its upgrade. This involves referencing Ren Le's research on ChatGPT to establish a creation traceability mechanism based on blockchain technology, using text fingerprint hash values to ensure the traceability of training data sources. Additionally, efforts should be made to develop infringement detection tools based on Generative Adversarial Networks (GANs). This technology uses generators to simulate potential infringement processes and discriminators to accurately identify text replication features. According to MIT's 2024 technology report, this method can increase the accuracy of infringement detection to 89% (MIT Artificial Intelligence Laboratory, 2024).

6 CONCLUSION

This study systematically deconstructs the copyright infringement risks associated with generative artificial intelligence throughout its data collection, model training, and content output processes, revealing the structural contradictions between technological features and legal rules. The findings indicate that infringement behaviors exhibit characteristics such as non-traceability, fragmented recombination, and a chain of responsibility distribution, which pose challenges to the traditional 'access + substantial similarity' framework in judicial practice. Empirical analysis shows that existing systems are systematically ineffective in identifying infringement methods, setting standards for liability allocation, and designing remedies. There is an urgent need to establish dynamic ownership rules, redefine originality standards, and refine fair use exemptions. By introducing the 'significant use' criterion and technical governance solutions, the study offers institutional innovation pathways to address the evidentiary challenges posed by algorithmic black boxes and the ineffectiveness of remedies due to the aggregation of minor infringements.

Future research can deepen exploration in three dimensions: First, develop infringement identification tools based on natural language processing, enhancing the efficiency of detecting infringing content through semantic vector analysis and generative adversarial networks (GANs). Second, conduct comparative studies of cross-border judicial rulings to refine the collaborative model between technical governance and legal regulation. Finally, establish a data certification mechanism for the entire process of generative AI creation, using blockchain technology to achieve visual traceability of training data sources. These advancements not only help improve the copyright system in the age of artificial intelligence but also offer a Chinese solution for the innovation of global digital governance rules.

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