Proceedings of ICLLCD 2025 Symposium: Enhancing Organizational Efficiency and Efficacy through Psychology and AI
DOI: 10.54254/2753-7064/2025.BO23977

Generative AI in Performance Design: Type Construction and Current Application Status

Ruiying Jia

College of Arts, Soochow University, Suzhou, China
JiaRuiying_Agnes@outlook.com

Abstract. Impelled by the digital era, performance design is rapidly evolving toward intelligentization. As a key force in the integration of technology and art, generative artificial intelligence is deeply involved in various stages of performance design, including creative content generation, real-time interaction, and system optimization. It is facilitating a shift from tool-assisted creation to human-AI co-creation and even AI-led design. Though there have been accomplishments, obstacles persist with respect to technical dependability, copyright acknowledgements, and human-AI cooperation. This paper outlines the contexts, functional categories, and technical frameworks through which generative AI intervenes in performance design, aiming to provide theoretical support and practical guidance for the development of intelligent performances.

Keywords: Artificial Intelligence (AI), Performance Design, Intelligent performance

1. Introduction

In the digital age, the performance model has gradually shifted towards intelligence. On the one hand, the audience's demand for immersive and personalized experiences has soared, and traditional preset performance designs are hard to meet the dynamic interactive needs. On the other hand, due to the impact of the COVID-19 pandemic, virtual performances have witnessed explosive growth in recent years, and the performing arts industry urgently needs efficient and low-cost intelligent solutions. Meanwhile, generative artificial intelligence (AI) provides a feasible solution for intelligent performances, building the framework of intelligent performances from both technical paths and theoretical foundations.

With the demand for digital and intelligent performances showing an explosive growth trend, artificial intelligence (AI) tools are also constantly evolving and improving. Driven by AI, intelligent performance design has achieved relatively mature results and successfully realized commercial application. However, during its application process, many limitations such as copyright disputes and the crisis of deep forgery have gradually emerged. This paper studies the ways in which generative AI is involved in performances, attempts to summarize its application path in performance design, and analyzes the existing problems and challenges, with the expectation of providing methodological guidance for subsequent intelligent performance design.

DOI: 10.54254/2753-7064/2025.BO23977

2. Ways for generative AI to intervene in performances

Generative AI is currently in a diverse development stage, intervening in performances through various means. There is no authoritative model framework for its application in performance design. Sorting out and analyzing the ways it intervenes in performances can clarify its application path in performance design and provide methodological guidance for subsequent intelligent performance design. Previously, Befera and Bioglio proposed a taxonomic framework for AI in contemporary cross-media drama based on different algorithm datasets and the symbolic systems of stage presentation in their research [1]. However, starting from the specific processes and contexts of performance design can offer more intuitive operational suggestions for R&D personnel in performance design. Therefore, this paper proposes a three-dimensional classification of the context, category, and architecture of generative AI's intervention in performance design.

2.1. Three scenarios of generative AI's involvement in the performance design process

According to the different stages of AI intervention in the performance design process, the intervention methods can be classified into "pre-performance intervention", "mid-performance intervention" and "post-performance intervention". Cornwell proposed a similar view. Based on Wolf Brown's "Arc of Engagement" model, he divided the audience participation in AI digital performances into five stages: preparation period - in-depth preparation period - artistic communication period - meaning construction period - impact response period, and analyzed and sorted out the application of AI in these stages [2]. Cornwell's theory focuses on the perspective of audience experience, while the perspective of the design process is weakened. Therefore, this paper proposes a classification method based on the design process as a reference. Among them, the "mid-performance intervention" stage basically includes the "preparation period", "in-depth preparation period" and "artistic communication period" in the "Arc of Engagement" theory; the "post-performance intervention" stage includes the "meaning construction period" and "impact response period" in the "Arc of Engagement" theory.

(1) Pre-performance intervention: Creative content generation. Before the performance, AI mainly serves in generating creative content, such as images, animations, audio, and videos. At this stage, AI art generation tools (like DALL-E or Midjourney) can be utilized to create unique visual concept art, AI animation generators (such as DeepMotion) can be used to produce dynamic character performances, AI tools for generating music (like OpenAI's MuseNet) can be employed to compose original soundtracks, and AI video editing software (such as Magisto) can be utilized to produce trailers and promotional videos, etc.

(2) Intervention in Performances: Real time, process. AI in theater performance increases the production workflow optimization and automation. When it comes to creating immersive visual effects with dynamic real time rendering system when combined with emerging digital technologies, AI shows its potential. Researchers such as O'Hare have many practical experiences in the field [3]. Notably, AI moves up from its more technical role to become a performing, autonomous, substantive part of the show or the narrative itself. AI establishes two way communication lines with audiences for the first time, practically, they’re AI lighting control architecture, algorithmic XR for adaptive scenes, NLP-based audience engagement as seen with IBM Watson. They make AI a multifunctional figure in current performance ecosystems, acting at the same time as technical infrastructure, creation co-author and interactive actor.

(3) Post-performance intervention: Communication and feedback analysis. The concept of “post-performance intervention” refers to AI-involved theatrical design operations happening subsequent to the live performance event, operating in an absence and temporal displacement. In this paradigm AI would connect to the performance dissemination via intelligent devices and provide an immersive

DOI: 10.54254/2753-7064/2025.BO23977

experience and personalization for audiences not at the venue. Examples on implementing AI: Sharing on various social media platforms for distribution of AI-curated performer's best moments, taking advantage of audience viewing habits when running promotional marketing, incorporating some AI systems like Iris+, with which similar systems could use spectators' comments from smart devices as part of an ongoing production. These apps show how AI can keep theatre engagement going past the ends of time and space, and make data-based loops for making art better.

2.2. Three taxonomic dimensions of generative AI intervention in performance design systems

Operational scope of generative AI within performance design systems can be systematically divided into three separate paradigms for implementation, namely content generation, interaction control and system optimization.

(1) Content Generation Architectures. AI-assisted content creation methods are fully covered regarding theatrical production components: going from narrative building with large language models (LLMs)-driven dynamic plot generation all the way toward multimedia structures which can also bring together textual and code-based data as visuals plus audio files. And they can also give birth to high-density contents with the performance.

(2) Intelligent Interaction Control Systems. AI enabled interaction framework operates on the principle of multi-channel feedback assessment and multi-agent control, forming a closed circuit with the environment in real time. To implement the above is to use sensors to assist in audience biometric monitoring (tracking physiological responses such as body temperature, heartbeat rate and expressions on the face), using affective computer-driven performance adjustment mechanism, as well as creating distributed architectures for distributed decision making to control pacing and level of detail with precision

(3) Performance Optimization Ecosystems. AI-boosted optimization protocols solve big production problems by two key methods. Technical strength frameworks rely on adversarial training procedures that lessen generating mistakes but make the system reliable. At the same time, computational efficiency systems conduct next-level rendering operations and optimize them, for example 5G-edge computing infrastructure for ultra-low-latency synchronization of digital content with physical stage apparatus, achieving ms-level temporal timing precision.

2.3. Three-tiered architecture of generative AI intervention in performance design systems

Technical application of generative AI within performance design could be categorized as 3 tiers according to how deep the AI's intervention is: Assistive Tier (L1), Collaborative Tier (L2) and Autonomous Tier (L3). They have different operational modes.

(1) Assistive Tier (L1): Instrumental Augmentation. At this fundamental level, AIs mainly act as creative prosthetics, augmenting the efficiency of human designers with aid from tools. Key implementation: AI generated performance asset library, auto-workflow orchestration. Though the AI intervention behavior of L1 is constrained a lot by human instructions, this generation process still depends on the self-interaction between data and algorithms. So human intervention is necessary for every stage from data selection, algorithm design, prompt input and finally output. [4] Cai et al. have started the intelligent analysis with motion recognition protocols [5], which forms the first mathematical quantification for traditional theatrical movements and helps improve performance processes.

(2) Collaborative Tier (L2): Human-AI Creation Frameworks. The intermediate stage is about symbiotic creativity and the AI goes from a tool to a thinking partner. The paradigm aligns with emerging research which argues that it is not replacement rather it is human-machine collaboration that should be the principle for artistic AI applications and standardised co- creation protocols are

DOI: 10.54254/2753-7064/2025.BO23977

needed that can leverage the ingenuity that humans have in the creative space in tandem with computational power [6]. It shows theatrical implementation via interacting system such as an interactive AI-powered "drama" "The Adding Machine" from project Feast; with real-time actors' conversation to AI which generates textual / audio response for them. and there are other application like AI music generating system which can do real time score variation and adaptive orchestration.

(3) Autonomous Tier (L3): AI-Driven Authorial Systems. AI occupies the top tier of the intervention hierarchy, taking on the main role of authorship and creatively autonomous by performing ecosystems. Exemplar include end-to-end AI theater productions (e.g., fully-automated drama without actors), and self-generating/evolving narrative structures (autonomously responding to the audience). This tier inverts the L1 Human-to–AI dynamic with an AI authoring and Human oversight mechanisms dynamic where the creative control falls unequivocally within the realm of the A.I. agents.

3. Problems and challenges of generative AI applications in performance design

The application of generative artificial intelligence (AI) in theater and performance design has introduced innovative visual aesthetics and interactive experiences, while simultaneously presenting a series of complex challenges. Recent research indicates that the integration of AI and new media technologies has fundamentally transformed the theatrical domain. However, in practice, this transformation brings about significant complications. While AI enhances real-time interactivity and data processing capabilities, it also introduces a high degree of unpredictability. Therefore, despite the promising expansion of expressive possibilities enabled by AI, its limitations and the impact on creative teams must be critically examined.

3.1. Technical limitations and reliability issues

Generative AI still hits a few bottlenecks on something as obvious as how timely it responds or how well it coordinates across modes. Current AI systems usually need a lot of computing power and specific data sets, which do not fit the speed of live stage shows. for example, Aïtouche et al [7] developed a distributed control system that shows that even when a structured environment is present, multi-agent collaboration needs precise fault-tolerant protocols to maintain system stability. They emphasized high reliability(fault-tolerant), flexible universal design and scalable distributed architectural requirements of stage supervision system. AI-choreographing or -motion generating also has a problem: They can be algorithmic biased, and will generate movements that are wrong in logic, or lag.

3.2. Disputes over copyright and authenticity

Generative AI on its own makes scripts, songs and visual material via algorithmic means; there’s lots of legal uncertainty around who counts as an author. The standards for what counts as original in AI work are still undefined, and current copyright law isn't able to say clearly how much of the contribution is human and how much is algorithm. For one thing, if an Artificial Intelligence was to create something, it would probably be a lot of text that’s already out there, and people may get concerned that this isn’t going to be seen as plagiarism [8]. Similar to this is the application of AI to create highly realistic likenesses of performances or their voices – often called “deepfake” technology in theaters: Befera and Bioglio mention a few instances in which AI-created imagery got incorporated into performances and found the distinction between virtual and real starts to get more unclear [1]. The former offers viewers new kind of aesthetic but at the same time there is risk of being deceived or used unfairly.

DOI: 10.54254/2753-7064/2025.BO23977

3.3. Challenges of human–AI collaboration

The adoption of generative AI as a "creative partner" in the theater might throw off the existing power structure. Designers, directors, and performers need to accommodate for working with AI systems that have inherently unpredictable behaviors. Design process automation can make traditional stage designers marginalized and transfer the creative control to algorithm systems. According to some researchers there are quite a lot of problems concerning ethics and expertise regarding the use of AI for theater. Also, with AI running on a level 3 narrative control structure, human intervention could be seen as unnecessary and thus undermine the subjective nature of creating art. In order to plug these algorithms into your scripts, to begin staging action, is to interrupt normal work. And it requires that we humans, as well as our AI partners, get used to this. It's the human teams who will need to interpret the output of the machines and guide it – but it also involves humans trusting a machine to contribute meaningfully to a performance.

4. Conclusion

Generative AI has driven performance design from static, preprogrammed presentations to dynamic, intelligent experiences by seamlessly integrating content creation, real-time interaction, and audience-driven feedback into a unified workflow; however, ensuring low-latency, fault-tolerant operation under live conditions, clarifying authorship and ethical responsibility in human–AI co-creations, and preserving human artistic agency amid increasing automation remain urgent challenges that must be addressed.

By framing AI intervention in terms of when it engages (before, during, after performance), what functions it serves (content generation, interactive control, system optimization), and how deeply it participates (auxiliary, collaborative, leading), this study offers a clear taxonomy of current practices while suggesting paths for developing hybrid workflows, refining ethical and legal frameworks, and designing scalable system architectures. These advances will be essential to realize intelligent performances that balance technological sophistication with human creativity, ensuring sustainable innovation in the era of AI-driven stage art.

References

[1] Befera, L., & Bioglio, L. (2022). Classifying contemporary AI applications in intermedia theatre: Overview and analysis of some cases. Workshop on Artificial Intelligence and Creativity. Workshop on Artificial Intelligence and Creativity, Udine, Italy.
[2] Cornwell, L. (2019). Using artificial intelligence for audience engagement in the performing arts.
[3] O'Hare, M. (2018). Points of contact: An actor-centered approach for the design of interactive environments for theatre performance [Ph.D.]. https://www.proquest.com/docview/2125560246/abstract/A37DAF51F83D4B97PQ/1
[4] Kwon, S. (2024). The identity of AI-generated images and the change of visual art. korean association for visual culture, 45, 5–28.
[5] Cai, Y., Kim, H. Y., & Dong, J. (2024). A study on the innovation of traditional drama performance forms by intelligent media based on AI-assisted analysis framework. Applied Mathematics and Nonlinear Sciences, 9(1), 20241632. https://doi.org/10.2478/amns-2024-1632
[6] Li, S. (2020). The trend and characteristic of AI in art design. Journal of Physics: Conference Series, 1624(5), 052028. https://doi.org/10.1088/1742-6596/1624/5/052028
[7] Aïtouche, A., Gehin, A. L., Flix, N., & Dumortier, G. (2002). Generic control/command distributed system – application to the supervision of moving stage sets in theaters. European Journal of Control, 8(1), 64–75. https://doi.org/10.3166/ejc.8.64-75
[8] Du, S. (2024). The opportunities and challenges of theater stage design in the era of artificial intelligence. Communications in Humanities Research, 38(1), 76–80. https://doi.org/10.54254/2753-7064/38/20240187