



Application Effect of AI Real Time Rendering Technology in Sports Live Streaming and Z Generation Market Prospect Analysis Based on Big Data

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Abstract. AI real-time rendering technology is reshaping the viewing ecosystem of sports live streaming and has become a core innovation to attract Generation Z users. The research finds that technical immersion, interactive participation and content personalization are the core driving factors, while usage threshold and content adaptability are the main constraints. The technology has broad application prospects in professional event broadcasting, folk sports promotion and sports IP derivative development. Moreover, policy support and industrial chain improvement will further accelerate its commercialization. This study provides empirical reference for the in-depth integration of AI real-time rendering technology and the sports live streaming industry, and also offers decision-making basis for industry participants to formulate Generation Z-oriented market strategies.

Keywords: AI Real-Time Rendering Technology, Z-Generation, Sports Live Streaming, Immersive Viewing Experience, Influencing Factors, Market Prospect, Big Data Analysis

1 Introduction

Against the global tide of deep integration of "sports + technology", the sports live streaming industry is undergoing a structural transformation from traditional one-way communication to immersive interactive experience. Media convergence has reshaped information production and consumption ecosystems ^[1]. Large-scale sports events face new opportunities and challenges in live broadcasting forms amid this trend. Media convergence has propelled sports live streaming toward immersion and interactivity, while user demands have shifted from single-mode viewing to immersive experiences and in-depth interaction. The breakthrough application of AI technology has become the core engine driving this change. Among them, AI real-time rendering technology, with innovative functions such as 360-degree free viewing angle switching, bullet time effects, and intelligent camera tracking, effectively addresses the industry pain points of traditional sports live streaming, including high broadcasting costs, limited visual

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expression, and insufficient interactivity. It provides an inclusive technical solution for multi-level event scenarios ranging from professional competitions to folk events like "Village BA" and "Village Super League".

AI real-time rendering is the deep integration of artificial intelligence (AI) and real-time rendering technology. Through algorithm and computing power optimization, it generates dynamic visual content (such as videos and virtual scenes) in an extremely short time, supports real-time interaction, and reconstructs the immersive experience and commercial value of sports live streaming. The technology applied in this study adopts a three-tier architecture: cloud AI computing layer, edge rendering layer, and terminal adaptation layer. Its rendering pipeline integrates AI-enabled modules into the traditional four stages (application, geometry processing, rasterization, pixel processing): the geometry processing stage captures the trajectories of 29 skeletal points of athletes via SlowFast Networks motion recognition algorithm to complete real-time 3D reconstruction of sports scenes (supporting the 360-degree free viewing angle function); the pixel processing stage achieves dynamic image denoising and super-resolution optimization through lightweight NeRF models (ensuring the fluency of bullet time effects). Core AI components include multi-view fusion algorithms, adaptive bitrate adjustment modules, and virtual avatar generation engines, tailored for the high dynamic and low-latency requirements of sports live streaming.

This technology has been practically verified in the Australian Open animated live broadcast: 12 cameras capture human silhouettes in real time, synchronously mapping real match movements to Q-version cartoon characters. It realizes an innovative form of "motion reproduction + scene cartoonization", addressing the pain point of traditional animation's long production cycle (over 48 hours). Compared with traditional rendering, AI real-time rendering breaks the limitation of local hardware, replacing fixed-pipeline operations with cloud distributed computing. It reduces rendering latency to the millisecond level and dynamically adjusts image precision via AI to balance clarity and transmission efficiency, overcoming the core shortcomings of traditional rendering—"time-consuming due to frame-by-frame light path calculation, reliance on high-end hardware, and inability to support real-time interaction".

Meanwhile, Generation Z has emerged as the core group of sports content consumption, with their viewing behaviors characterized by distinct socialization, multi-device collaboration, and personalized demand orientation. Over 90% of Generation Z consumes sports content through social media, and their preference for immersive and interactive experiences is significantly higher than that of previous generations. The global market size of AI sports event live streaming is expected to reach tens of billions of yuan by 2025, with a compound annual growth rate exceeding 20%.

Technological iteration—a core driver of the sports media industry's transformation—has reshaped sports live streaming and the broader sports media ecosystem. Against the backdrop of Gen Z's rise as core consumers and the booming AI sports live streaming market, scholars have researched shifting media forms and fans' viewing behaviors.

Brett et al. (2012) argued that television is no longer the sole carrier for disseminating sports footage and information; the rise of digital media has fundamentally reshaped sports media's production and consumption dynamics^[2]. Building on this, Walter et al.

(2014) noted television remains the top choice for live viewing due to its signal fidelity, sense of presence, and top-tier event broadcasting rights. Meanwhile, emerging digital media enhance experiences via interactivity and autonomy—their competition in live sports is not a zero-sum game^[3]. Complementing this, Tamir (2019) found through empirical research that even with delayed viewing options, sports fans (including Gen Z) insist on real-time watching, a phenomenon rooted in their community identity and deep team bonds^[4]. Yet, as the industry embraces AI innovations to meet Gen Z's immersion and interaction demands, critical research gaps persist.

Gen Z is the core sports content consumer group, with viewing behaviors characterized by socialization, multi-device collaboration, and personalized demands. Over 90% consume sports content via social media, and their preference for immersive, interactive experiences far exceeds previous generations. The global AI sports live streaming market is expected to reach tens of billions of yuan by 2025, with a CAGR exceeding 20%. Despite promising prospects and strong demand, existing studies lack clarity on Gen Z's acceptance of AI real-time rendering technology, with scarce regional empirical research on young groups; research on online sports live streaming audiences' value co-creation models also remains insufficient^[5]. Focusing on Shanghai's young groups, this study explores AI real-time rendering in sports live streaming. Using questionnaires, interviews, and big data analysis, it identifies key drivers and constraints of Gen Z's acceptance, aiming to predict commercialization paths, provide strategy support for stakeholders, and enrich the academic system on AI application in sports.

2 Research Methods

2.1 Sample Design and Data Collection

The study adopted a multi-stage sampling method, selecting Generation Z individuals aged 18-26 from 6 administrative districts in Shanghai (including Pudong New Area, Huangpu District, Jing'an District, etc.) as research objects. The sample covered core sports consumer groups such as students and new entrants to the workplace. The survey was conducted from March to April 2024, with questionnaires distributed through online survey platforms and offline event scenarios. A total of 291 valid questionnaires were collected, with an effective recovery rate of 89.2%. The sample showed balanced gender distribution, an age concentration of 72.5% in the 20-24 group, a primary viewing frequency of 1-3 times per week, and a preference for football, basketball, and e-sports. Simultaneously, 12 respondents were selected for semi-structured in-depth interviews, including 5 high-frequency viewers, 4 sports event practitioners, and 3 technology industry researchers. The interviews focused on three dimensions: technology usage experience, pain points of demand, and market expectations. Each interview lasted 30-45 minutes, and the interview recordings were transcribed into textual data. The six selected administrative districts ensure sample representativeness with distinct demographic and consumption characteristics. Offline questionnaires were distributed at sports events and young people-intensive places, while online questionnaires were disseminated through social media platforms, covering different subgroups of Generation Z to avoid sampling bias.

2.2 Research Tools and Analysis Methods

Referring to the Technology Acceptance Model (TAM) and consumer behavior theory, a questionnaire titled "Willingness to Use AI Real-Time Rendering Technology in Sports Live Streaming" was designed. It included 4 dimensions (technological characteristics: ease of use, innovation; experience perception: immersion, sociality; usage intention; market prospects) with a total of 22 items. A 5-point Likert scale was adopted for scoring (1=Strongly Disagree, 5=Strongly Agree). The reliability and validity of the questionnaire were verified to be good (Cronbach's α coefficient = 0.895, KMO value = 0.884, $p < 0.001$). Data processing was performed using SPSS 26.0 and Python: descriptive statistics were used to present sample characteristics and variable distribution; Pearson correlation analysis was employed to test the correlation between variables; multiple linear regression model was used to identify key factors influencing usage intention; big data text mining technology was utilized for keyword extraction and thematic clustering of interview texts. For text mining of interview data, Python's jieba (a Chinese word segmentation tool) word segmentation and LDA (Latent Dirichlet Allocation) thematic clustering models were used to extract core keywords and classify thematic categories, with the consistency test of coding results showing a Kappa coefficient of 0.87, indicating high reliability of the analysis results.

3 Results and Analysis

3.1 Sample Viewing Behavior and Technology Cognition

Descriptive statistics showed that Generation Z's core demands for sports live streaming focused on "picture experience" ($M=3.85$, $SD=0.61$), "interactive participation" ($M=3.72$, $SD=0.58$), and "social sharing" ($M=3.68$, $SD=0.63$). This aligns with the findings of Cheng and Li (2024), who noted that content attributes and platform characteristics significantly facilitate user social interaction^[6]—a trend particularly prominent among Generation Z, who are highly dependent on social media. Regarding the cognition of AI real-time rendering technology, 38.5% of respondents were "very familiar" and had used related functions, 45.7% were "somewhat familiar" but had not tried, and only 15.8% were "completely unfamiliar". Among the used technical functions, 360-degree free view (62.2%), bullet time effect (57.4%), and intelligent tracking camera angle (48.1%) were the most popular. Further analysis of demographic differences shows that student groups have a higher preference for "social sharing" ($M=3.81$, $SD=0.59$) than new workplace entrants ($M=3.52$, $SD=0.65$), while new workplace entrants pay more attention to "picture experience" ($M=3.94$, $SD=0.57$) due to higher consumption capacity. In terms of preferred sports types, e-sports fans have the highest recognition of AI real-time rendering technology (47.2% are "very familiar"), followed by basketball fans (39.6%) and football fans (36.8%). This is related to the early application of 360-degree free view and bullet time effects in e-sports and basketball live broadcasts, which enables users to accumulate more usage experience.

3.2 Results of Multiple Regression Analysis

To further quantify the key drivers of usage intention identified in the preliminary analysis, a multiple linear regression was conducted. The model (Table 1) showed a good overall fit ($F=32.76$, $*p<0.001$), with an adjusted $R^2=0.387$, indicating that the selected variables could explain 38.7% of the variation in usage intention. Among them, immersive experience ($\beta=0.328$, $p<0.001$), technology ease of use ($\beta=0.245$, $p<0.001$), and social attribute ($\beta=0.186$, $p<0.01$) were key positive factors influencing Generation Z's usage intention, while technology cost ($\beta=-0.105$, $p<0.05$) was a negative influencing factor.

Table 1. Results of Regression Analysis on Influencing Factors of Usage Intention

<i>Variables</i>	<i>Standardized Coefficient β</i>	<i>t-value</i>	<i>p-value</i>
<i>(Constant Term)</i>	-	2.315	0.021
<i>Immersive Experience</i>	0.328	5.723	0.000
<i>Technology Ease of Use</i>	0.245	4.386	0.000
<i>Social Attribute</i>	0.186	3.217	0.001
<i>Technology Cost</i>	-0.105	-2.034	0.043

Note: $R^2=0.398$, Adjusted $R^2=0.387$, $F=32.76$, $p<0.001$

3.3 Further Regression and Logistic Analysis

To gain a deeper understanding of the impact of AI real-time rendering technology on user behavior and its commercial potential, further regression analysis and ordered logistic regression were conducted, focusing on user stickiness and payment willingness.

To explore how the technology and the viewing experience it creates jointly affect user engagement, a multiple linear regression was performed with user stickiness as the dependent variable. As presented in Table 2, both viewing experience ($\beta = 0.512$, $p < 0.001$) and AI real-time rendering technology perception ($\beta = 0.427$, $p < 0.001$) were significant positive predictors. This confirms that the technology not only enhances the viewing experience but also directly and indirectly strengthens user stickiness.

Table 2. Regression Analysis on the Impact of Viewing Experience and AI Technology on User Stickiness

<i>predictor</i>	<i>Unstd. Coefficient (B)</i>	<i>Std. Coefficient (β)</i>	<i>t-value</i>	<i>p-value</i>
<i>(constant)</i>	0.083	-	0.882	0.378
<i>viewing experience</i>	0.512	0.522	11.376	<0.001
<i>AI Technology</i>	0.427	0.421	9.189	<0.001

Note: $R^2 = 0.817$, Adjusted $R^2 = 0.816$, $F = 642.39$, $p < 0.001$.

To further investigate the determinants of commercialization, an ordered logistic regression was employed to analyze the factors influencing users' payment willingness.

The results, shown in Table 3, indicate that technological innovativeness ($B = 1.277, p < 0.001$) and content personalization ($B = 0.766, p = 0.007$) are key positive drivers. In contrast, price ($B = -0.543, p = 0.032$) and brand influence ($B = -0.922, p = 0.001$) exhibit significant negative effects, highlighting the major barriers to paid adoption.

Table 3. Ordered Logistic Regression Analysis of Factors Influencing Payment Willingness

Factor	Coefficient (B)	Std. Error	Wald χ^2	p-value	Odds Ratio [Exp(B)]
Technological Innovativeness	1.277	0.35	13.878	<0.001	3.585
Content Personalization	0.766	0.281	7.172	0.007	2.152
Price	-0.543	0.256	4.584	0.032	0.581
Brand Influence	-0.922	0.274	11.644	0.001	0.397

Note: Model fitting information: $\chi^2 = 24.969, p < 0.001$.

3.4 Structural Equation Modeling Analysis

To further validate the hypothesized relationships among the core constructs in a comprehensive model, a Structural Equation Modeling (SEM) analysis was conducted. The model fit indices (CMIN/DF = 1.554, RMSEA = 0.044, CFI = 0.987) indicate a good fit between the model and the data. The standardized path coefficients are shown in Fig.1 and Table 4.

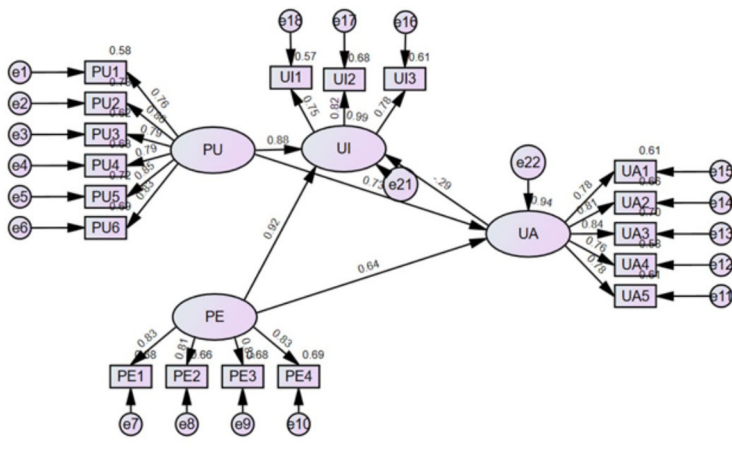


Fig. 1. Structural Equation Model (SEM) illustrating the hypothesized relationships among core constructs.

Table 4. Structural Equation Model (SEM) Path Estimates

<i>path</i>	<i>standardized coefficient</i>	<i>Non standardized coefficient</i>	<i>Standard Error</i>	<i>t-value</i>	<i>P-value</i>	<i>Assume the support is established</i>
<i>UA←-PU</i>	0.728	0.581	0.042	13.922	***	Support
<i>UA←-PE</i>	0.639	0.506	0.038	13.223	***	Support
<i>UI←-UA</i>	-0.292	-0.282	0.336	-0.838	0.402	Not Supported
<i>UI←-PU</i>	0.877	0.675	0.205	3.292	***	Support
<i>UI←-PE</i>	0.923	0.705	0.183	3.853	***	Support

Note:***=P<0.001

3.5 Core Findings from Interviews

Text mining revealed three core themes from the interviews. Generation Z users valued the enhanced control and detail capture offered by features like free view switching ("free view makes viewing more controllable"). Practitioners highlighted the technology's potential to reduce production costs and expand coverage for small and medium-sized events, noting its role in popularizing grassroots sports. Researchers pointed to the synergy with big data for personalized content and increased user stickiness, while also envisioning future integration with VR for fully immersive, personalized virtual stadiums to meet diverse user needs.

4 Discussion

The research confirms that immersive experience is the core driver for Generation Z's acceptance of AI real-time rendering technology. The significant role of ease of use aligns with the TAM model's core assumption, while the positive impact of social attributes reflects this group's tendency toward "social consumption"—consistent with Symbolic Interactionism [7]. Technology cost remains a key constraint, indicating a need to balance performance and affordability, in line with the trend toward "inclusive development" in sports streaming.

Compared to studies on general audiences, this research highlights Generation Z's emphasis on emotional and social value, consistent with their preference for innovative viewing experiences. Practical applications, such as Shanghai Media Group's InnoMotion AI in Olympic broadcasts and Shenzhen Immersive Vision's iSportAgent in grassroots events, validate that enhancing immersion and reducing costs are effective commercialization paths.

The study contributes by revealing the acceptance mechanism among a regional Generation Z sample, combining big data with traditional methods to improve robustness. A limitation is the Shanghai-only sample, suggesting caution in generalizing findings. Future research should expand to cross-regional comparisons.

5 Conclusions

This study clarifies the influencing factors of AI real-time rendering in sports streaming through empirical research on Generation Z in Shanghai. Immersive experience, ease of use, and social attributes are identified as core drivers of acceptance, while technology cost remains the primary constraint.

Corresponding strategies are proposed: enhancing key immersive and social features, lowering cost barriers through technical and pricing innovations, and extending applications to grassroots events. Academically, this work enriches empirical research on AI in sports, providing Generation Z-specific evidence for relevant theories. Practically, it supports the integrated development of “Sports + AI + Big Data,” promoting personalized, immersive, and inclusive industry transformation—aligned with the theme of AIBDF 2025. Policymakers are encouraged to foster innovation and inclusive adoption through incentives and pilot programs in grassroots sports.

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