



AI-Empowered Tourism Industry under Spatiotemporal Reconstruction and Localized Innovation

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Abstract. This research explores AI's transformation of tourism through literature analysis, identifying key challenges: algorithmic bias, tech fragmentation, ethical dilemmas, and digital divides. It develops a "spatiotemporal compression-reconstruction-collaboration" framework, revealing: 1) Virtual-physical integration creates multidimensional spaces across sky-ground-earth domains; 2) Emotion-aware computing enables context-specific LBS networks; 3) Localized innovation evolves AI roles from tools to digital residents. Practical strategies suggest innovations in hybrid tourism products, cultural digitization, and dynamic experience design, alongside service optimization through precision algorithms and inclusive ecosystems. The proposed "technology-ethics-policy" governance mechanism addresses data barriers, facilitating AI's transition from efficiency enhancer to value creator. Findings provide theoretical and practical guidance for sustainable smart tourism development.

Keywords artificial intelligence; human-machine collaboration; affective computing; digital cultural Tourism

1 Introduction

Technological transformation reshapes tourism development opportunities and challenges from Informatization to Intelligentization. Under the tide of technological evolution spanning informatization, digitization, and intelligentization, the tourism industry faces unprecedented opportunities and challenges. Tourist demands have evolved from personalization and embodiment to emotionalization, while tourism products transition from differentiation to scenario-based dynamism, and services shift from standardization to refined frictionless delivery (Yang, 2024). This paradigm shift necessitates fundamental transformations in the attributes and boundaries of tourism products, as well as the content and quality of services. A critical breakthrough lies in leveraging intelligent technologies to empower product innovation and service reconfiguration.

1.1 Dissolution of Spatiotemporal Boundaries

Traditional discussions on physical tourism—covering destinations, scenic areas, comprehensive tourism planning, and related topics—have emphasized geographical constraints, prioritizing the locality and immediacy of tourism products, services, behaviors, and experiences within “non-habitual environments” (Wang et al., 2025). However, technological advancements have catalyzed dual transformations: (1) Spatio-temporal Compression: Short-duration, short-distance tourism has gained prominence, reflecting condensed spatial and temporal dimensions of physical tourism; (2) Virtual-Physical Synergy: Maturation of VR/AR and metaverse technologies positions virtual tourism as a complementary or partial substitute for physical travel. Immersive hybrid experiences are redefining scenic area innovation, dissolving spatial constraints and weakening temporal limitations on tourist behaviors and experiences.

1.2 Reconfiguration of Multidimensional Spaces

Traditional tourism research primarily focused on geographical physical spaces—landforms, flora/fauna, streetscapes, and infrastructure. Inspired by Lefebvre’s triadic space theory, interdisciplinary perspectives now propose diverse “triadic space” frameworks: Information-Physical-Social spaces (information science), Natural-Economic-Sociocultural spaces (economic geography), Physical-Mental-Epistemic spaces (philosophy), Place-Mobility-Meaning spaces (communication studies), Material-Cultural-Informational spaces (heritage tourism), Cultural-Behavioral-Design spaces (architecture). Tourism spaces inherently represent organic overlays of multidimensional spaces within tourists’ perceptual ranges, as single spatial dimensions inadequately capture complex experiential scenarios. Technological integration—including remote sensing, drone photogrammetry, 3D modeling, and BIM—enables precise spatial digitization and management. The “air-space-ground” integrated system transcends single-scale limitations, facilitating cross-scale spatial computation, planning, and operational practices in multidimensional tourism spaces (Xiang, 2024).

1.3 Deepening Human-Place Interactions

The shift from humanistic geography to emotional geography highlights growing emphasis on embodied experiences and intrinsic emotional engagement in spatial contexts, a trend now permeating tourism research. By correlating spatiotemporal dynamics with emotional experiences, the integration of traditional tourist behavior studies and AI algorithms unveils new paradigms for human-place interactions, marking a transition from “spatial intelligence” to “affective intelligence” in tourism research (Fang, 2024).

Consequently, investigating AI’s role in empowering the tourism industry emerges as a critical research imperative

2 Methods

This research primarily employs a systematic literature review as the core method for data collection and analysis, aiming to comprehensively investigate the current status, models, impacts, and development trends of AI-empowered tourism. The implementation process involved the following key steps:

2.1 Literature Search Strategy

An extensive and systematic literature retrieval was conducted utilizing authoritative academic databases such as CNKI, Wanfang Data, Web of Science, and EBSCOhost. Search queries combined core keywords including “AI-empowered tourism industry,” “artificial intelligence applications in tourism,” and “intelligent development of tourism,” with supplementary terms like “tourism service optimization,” “tourism marketing innovation,” and “tourism management transformation.” This multidimensional search strategy ensured comprehensive coverage of critical research dimensions within the field. Additionally, grey literature—including industry reports, conference proceedings, and white papers published by leading tourism enterprises—was supplemented via Google Scholar to enrich data diversity.

2.2 Literature Screening Criteria

Following initial retrieval, a rigorous screening process was implemented based on four criteria: Academic Authority: Prioritizing peer-reviewed journals and high-impact publications; Methodological Rigor: Selecting studies with robust research designs; Thematic Relevance: Excluding marginally related or low-quality works; Temporal Validity: Focusing on literature published within the last decade (2014 - 2024).

2.3 Analytical Process

The refined corpus underwent meticulous critical reading and thematic analysis. Content analysis techniques were applied to identify emerging patterns, while comparative analysis revealed disciplinary divergences in AI application frameworks. NVivo 14 software facilitated the coding of key concepts, enabling systematic categorization of technological implementations, ethical challenges, and innovation pathways.

3 Data analysis and Discussion

3.1 Challenges Faced by AI Empowerment in the Tourism Industry

Currently, the rapid development of artificial intelligence is profoundly reshaping the landscape of the online tourism sector, driving substantial transformations in information generation, transmission, interaction, and application on tourism digital platforms. However, while AI brings convenience and high efficiency to these platforms, systemic risks such as algorithm manipulation, technological apathy, and privacy erosion are leading to new forms of market failure (Grundner & Neuhofer, 2021). This has

triggered a series of contradictions, including the dynamic game between intelligent summarization and creative suppression, the value conflict between personalized recommendations and big - data price discrimination, the service gap between high - efficiency responses and technological apathy, and the development imbalance between intelligent services and digital inclusivity. Fig. 1 shows the challenges faced by AI in the tourism industry.

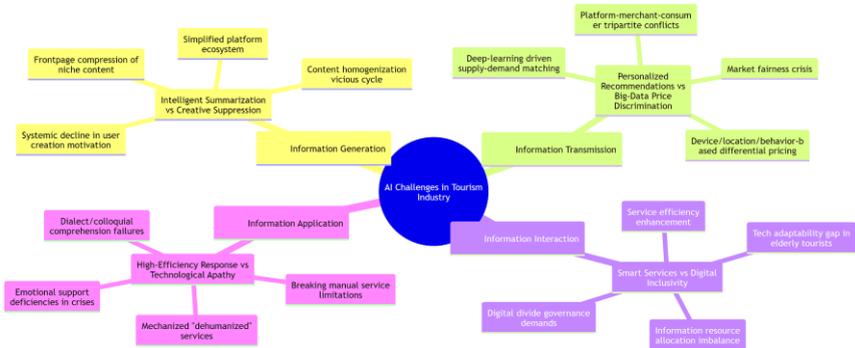


Fig. 1. The challenges faced by AI in the application of the tourism industry

Information Generation: The Contradiction between Intelligent Summarization and Creative Suppression

. AI - based recommendation algorithms analyze and summarize user - generated content and prioritize its display on the front page of reviews. This enables high - quality or content that aligns with the interests of the majority of users to be discovered, reducing users' information search costs and improving the efficiency of information acquisition. At the same time, it brings about a series of negative effects. Firstly, this method of homepage presentation compresses the visibility space for non - mainstream or niche user - generated content, leading to a systematic decline in the creative motivation of potential contributors. Secondly, to increase exposure, some users may be inclined to produce content that caters to popular tastes rather than truly valuable content, further exacerbating the trend of platform content homogenization. In the long run, a vicious cycle of "declining exposure of contributed content - weakened user motivation/homogenized user output - simplified platform ecosystem" gradually forms.

Information Transmission: The Contradiction between Personalized Recommendations and Big - Data Price Discrimination

. By utilizing deep - learning algorithms, AI enables platform data to possess the ability of "autonomous behavior" based on users' past preference settings, operational experiences, and behavioral data, achieving precise matching of tourism service supply and demand (Li et al., 2025). However, tourism digital platforms implement differentiated pricing through big data and algorithms based on characteristics such as users' devices, geographical locations, and browsing behaviors. How to ensure fairness and transparency while maintaining personalized services has become an important issue that tourism digital platforms urgently need to address.

Information Interaction: The Contradiction between Intelligent Services and Digital Inclusivity

. AI drives the transformation of tourism digital platforms and reconstructs the service interaction mechanism, significantly improving service efficiency and user experience. However, it has also led to a phenomenon of technological application gaps. Specific groups, such as middle - aged and elderly tourists, due to their insufficient technological adaptability and difficulties in operating smart devices, find it challenging to reap the benefits of digital services, showing obvious disadvantages in the online tourism consumption ecosystem. This systemic difference not only leads to the differentiation of information access channels but also triggers a deep - seated imbalance in the information resource allocation mechanism. Building a technology - inclusive system, reducing the digital divide among users, and achieving the coordinated development of platform information equity and resource sharing have become strategic issues that need to be urgently addressed in the era of digital tourism.

Information Application: The Contradiction between High - Efficiency Responses and Technological Apathy

. The emergence of AI - powered customer service has addressed the limitations of manual customer service, such as restricted working hours and low response efficiency. It can solve a series of problems related to flight ticket bookings, hotel selections, and itinerary arrangements according to users' needs, reducing users' information search costs (Samara et al., 2020). However, AI is not perfect, and its technological limitations and practical deficiencies are still widely criticized, often being ridiculed as "artificial idiocy." On the one hand, intelligent customer service cannot understand dialects and colloquial expressions, and there is still information fragmentation when processing context. On the other hand, the mechanical and programmatic expression of AI customer service often leads to a "dehumanized" tendency in its services, trapping it in the dilemma of technological apathy.

3.2 Paths for AI Empowerment in the Tourism Industry

Promoting AI to assume diverse roles in tourism scenarios is conducive to advancing the process of "AI + Tourism" and reconstructing tourists' travel experiences, thereby achieving the goal of industrial upgrading.

Intelligent Technology Empowers Tourism Product Innovation

. Morphological Innovation of Tourism Products. Under a new spatiotemporal perspective, intelligent technology enables the digital interpretation of tourism resources in the information space. This includes the realistic reproduction of tourist destinations, the creation of autonomous virtual environments, immersive experiences of historical events, and the virtual restoration of cultural relics and historic sites. Tourism products are presented in various forms such as web pages, application software, mini - programs, and game modules. Meanwhile, intelligent technology empowers the co - existence of the virtual and the real for tourism resources in the physical space, achieving localized digital twins. The generation process of such products can also involve the autonomous participation of tourists, enhancing the sense of experience and interactivity and meeting tourists' needs for self - expression and social value.

Intelligent Technology Empowers the Reconstruction of Tourism Services

. Precise Matching of Tourism Services. Relying on real - time data collection and dynamic resource scheduling, combined with precise user characteristic analysis and emotion modeling, intelligent technology supports the reorganization of service time and space and the human - centered reconstruction, achieving a precise fit between the tourism supply side and consumer demands. For example, localized services in scenic spots employ innovative applications such as real - time itinerary planning guided by visual preferences, comfort warnings based on the linkage between environmental perception and physiological parameters, catering recommendations that integrate regional cultural characteristics and word - of - mouth data, and diversion guidance that coordinates the physical carrying capacity of scenic spots with tourists' psychological thresholds. These practices have constructed a scenario - based instant service network based on LBS (Location - Based Services) technology, significantly enhancing tourists' cultural perception experiences while alleviating the environmental load of scenic spots.

Localization of AI as a Service Tool

. To reduce business costs, improve productivity, and address labor shortages, AI, as a service tool, is being widely applied. It is projected that the service robot market will grow to \$23.3 billion by 2032 (Hoang et al., 2025). Given the significance of tourism services, the tourism industry has emerged as a pioneer in AI service applications. Ranging from basic service robots to AI - based high - precision itinerary planning and AI - guided tours embedded with large language models, AI serves as a fundamental service tool in tourism. As tourists' demands for AI services continue to rise, localized service design has become a crucial approach to enable AI to deliver precise and personalized services and enhance its tool value. Thus, for AI as a service tool, localization primarily manifests in its deep understanding of regional cultures, language habits, and environmental characteristics, thereby avoiding service disconnections caused by “technological universality.”

Localization of AI as a Local Ambassador

. The core value of AI as a local ambassador lies in its controllability, novelty, and cultural adaptability. Compared with human ambassadors, AI can not only convey destination information at a lower cost and with higher stability but also engage in one - on - one personalized interactions, establishing deep connections with (potential) tourists. The key to realizing its effectiveness lies in localized design—that is, breaking through the “standardized” image of AI by integrating local cultural symbols and attracting tourists through emotional arousal and cognitive contrasts. Existing research has indicated that when AI ambassadors use local accents instead of standard Mandarin to attract tourists, the willingness of potential tourists to visit the destination increases significantly (Li et al., 2025). This is because such “localized” design shatters people's perceptions of AI as mechanical and standardized, creating a sense of surprise for tourists while implying that the destination possesses technological advancement and cultural uniqueness, thereby enhancing tourists' confidence in the quality of the destination's services and experiences (Hoang et al., 2025). In the future, tourism AI needs to further delve into local expressions. Only when AI ambassadors become the “digital mirrors” of the local cultural fabric can they truly achieve an upgrade from information

transmission to emotional mobilization, propelling AI - based destination marketing from “catching the eye” to “winning the heart.”

Localization of AI as a Digital Resident

. The innovative practice of AI as a digital resident is redefining the experience boundaries and cultural ecology of cultural and tourism scenarios. These digital humans, with human - like appearances, language interaction capabilities, and learning abilities, can become digital residents of destinations by deeply integrating into the local cultural system, thus becoming an important driving force for the transformation of the cultural and tourism industry. From a functional value perspective, localized AI residents, as digital carriers of cultural heritage, can activate the reproduction of local cultures. For example, the “Xiao Jinhua” AI in Dali not only incorporates the Bai ethnic group’s tie - dyeing techniques in its design process but also teaches tourists how to perform tie - dyeing. At the same time, they can also serve as guides for immersive experiences, overturning the “check - in” style of tourism and promoting industrial transformation and upgrading. When AI truly integrates into destinations as “digital natives,” the cultural and tourism industry will usher in a comprehensive revolution from spatial consumption to meaning production.

4 Conclusion

At the current stage, there are still multiple development barriers to the integration of artificial intelligence (AI) and the tourism industry. The core issues are centered around the lack of ethical norms, information security vulnerabilities, insufficient collaboration efficiency, and an imbalanced distribution of technology. The user personas and preferences formed by the rigidification of algorithm models are prone to triggering the information cocoon effect. Copyright disputes and the spread of false information caused by the misuse of generative technologies continue to erode the foundation of consumer trust. Frequent personal information leaks and privacy protection vulnerabilities highlight the security fragility in the process of technology application. Compounded by the shortage of professional talent supply and enterprises’ anxiety about digital transformation, the grass - roots operational system struggles to bear the demands for systemic innovation. To break through these development bottlenecks, it is necessary to focus on constructing an ethical constraint framework, improving the data security supervision system, innovating cross - platform collaboration models, and promoting the implementation of technology - inclusive policies. Ultimately, a safe, controllable, inclusive, and shared development pattern for intelligent cultural and tourism can be created.

References

1. Fang, H. (2024). Research on the Application of AI Technology in the Digital Development and Promotion of Tourism Resources. *Global Human Geography*, (24), 146-148.
2. Hoang, C., Liu, X., & Ng, S. (2025). From Premium to Mass: How Service Robots Shift Brand Premiumness. *Journal of Service Research*, 28(1), 17-34.

3. Grundner, L., & Neuhofer, B. (2021). The bright and dark sides of artificial intelligence: A futures perspective on tourist destination experiences. *Journal of Destination Marketing & Management*, 19, 100511.
4. Li, C., Qu, Z., & Yang, Y. (2025). Localizing matters: The effect of AI accent on tourist travel intention. *Journal of Destination Marketing & Management*, 36, 100992.
5. Samara, D., Magnisalis, I., & Peristeras, V. (2020). Artificial intelligence and big data in tourism: a systematic literature review. *Journal of Hospitality and Tourism Technology*, 11(2), 343-367.
6. Wang, J., et al. (2025). Artificial Intelligence (AI) Empowering High Quality Development of Tourism Industry: New Opportunities, Challenges, and Paths. *Ecotourism in China*, (01), 1-18.
7. Xiang X. (2024). Research on the Application Path of Technology in Human Resource Management of Tourism Industry. *Outlook on Bohai Rim Economy*, (10), 43-46.
8. Yang, Q. (2024). Research on the Development Strategy of Sports Tourism Industry in Henan Province under the Background of "Digital China". *Journal of Henan University of Finance and Economics*, 33 (02), 84-8

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