Post-print: Reflections on Spatial Journalism Practice Based on Media Technology Development With the maturation of technologies such as virtual reality, augmented reality, and mixed reality, journalism is undergoing a spatial transformation. Traditional news narratives rely on linear text and tw···

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Abstract

【Objective】 Spatial journalism is a theoretical framework that integrates space, place, and location into the production practices of journalism. Against the backdrop of the new technological revolution, this article aims to investigate how the development of high technologies prompts media organizations to transform news production models and extends spatial concepts throughout the journalism industry.【Method】The article delineates the concept of spatial journalism and its evolution, employing survey research, textual analysis, and case study methods to examine, within the framework of journalism and communication studies, the relationship between the developmental practices of media technology and the evolution of spatial concepts. 【Results】 Continuous innovation and convergence of technologies such as mobile positioning, big data, artificial intelligence, and virtual reality have transformed spatial narrative modes in news production and created content with richer spatial dimensions.【Conclusion】For news media, new technologies have influenced the methods of news production and processing, prompting journalism practitioners to engage in all-media, immersive, and three-dimensional reporting, thereby endowing spatial journalism with the possibility of transitioning from theory to practice.

Full Text

Preamble

Reflections on the Practice of Spatial Journalism in the Context of Media Technology Development

(People' s Daily Media Technology Co., Ltd., Beijing 100733)

Abstract:
[**Purpose**] Spatial journalism is a theoretical framework that integrates space, place, and location into journalistic production practices. Against the backdrop of the new technological revolution, this study examines how advances in high technology are prompting media organizations to transform news production models and extending the spatial concepts of the entire journalism industry. [**Method**] This article analyzes the concept and evolution of spatial journalism, employing survey research, textual analysis, and case studies to explore the relationship between media technology development practices and the evolution of spatial concepts within the framework of journalism and communication studies. [**Results**] Continuous innovation and integration of technologies such as mobile positioning, big data, artificial intelligence, and virtual reality have transformed the spatial narrative modes of news production and created content with richer spatial dimensions. [**Conclusion**] For news media, new technologies have influenced news production and processing methods, encouraging journalists to engage in all-media, immersive, and three-dimensional reporting, thereby endowing spatial journalism with the possibility of moving from theory to practice.

Keywords: spatial journalism; location data; immersive journalism; extended reality

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"Space" is one of the fundamental concepts in journalism and communication studies, considered alongside "time" as two indispensable dimensions of information transmission [1]. Journalism can be understood as a process whereby communicators process events occurring in specific spatiotemporal contexts and disseminate them through media, enabling audiences to experience those particular spaces and times. In communication studies, space signifies more than mere geographical markers or physical existence; it concerns the reorganization of social relations and the practice of social order, connecting technological dynamics, place-based practices, cultural implications, and psychological activities through the discursive dimension of spatial fields [2].

The rapid advancement of science and technology, particularly internet-based media technologies, along with the resulting transformations in social structures and relations, constitutes both the practical necessity and perpetual driving force for the development of journalism and communication as a discipline. Within this field, traditional concepts of space have been altered under the influence of information technology, shifting from substantive physical space to cyberspace, virtual space, and immersive space. The spatial scale perceived psychologically by individuals is shrinking infinitely, while space itself is developing toward multi-dimensionality and multi-modality.

1. The Development of Spatial Journalism

In recent years, spatial journalism has gradually garnered attention from communication scholars both in China and abroad. As the term suggests, spatial journalism is a theoretical framework that integrates space, place, and location into journalistic production practices, where "space" can be physical, augmented, or virtual. The earliest proponent of spatial journalism was Dr. Amy Schmitz Weiss from San Diego State University, who introduced the concept of "spatial journalism" in 2015 and elaborated on its origins and development abroad from four perspectives: journalism studies, mobile technology, internet theory, and locative media [3].

In China, research on spatial journalism has also entered the 视野 of communication scholars. Professor Bai Hongyi from Fudan University notes that current attention to space in journalism studies manifests in two characteristics: first, increasing focus on geographical concepts such as space, location, and place; and second, the active adoption of spatial metaphors from social theory—including field, ecology, ecosystem, boundary, network, and world—as theoretical resources for journalism researchers [4]. Wang Peinan and Shi Anbin from Tsinghua University observe that the post-pandemic era has rapidly made "communication in the cloud" a reality, with cloud-based connections transforming news production models. News production is gradually transcending temporal and spatial limitations to enable remote collaboration, thereby extending spatial concepts across the entire journalism industry and prompting the rise of "spatial journalism" [5].

In 2021, *The New York Times*' Research & Development Lab established a new department dedicated to researching issues related to "spatial journalism." The Lenfest Institute for Journalism also created the "Local Lab" to explore the connections between location-based news and community services, public affairs, and other areas [6].

Currently, after more than 30 years of internet development, we stand at a critical juncture in the evolution from Web 2.0 to Web 3.0. Web 3.0 represents not only an intelligent internet characterized by decentralization, distributed storage, and data interconnection, but also serves as the underlying infrastructure for the recently hotly debated "metaverse." The metaverse is a three-dimensional

holographic internet—a digital living space constructed by humans using technology, a virtual world parallel to and interactive with the real world that can provide users with unprecedented immersion and participation.

Supporting the metaverse requires numerous core technologies, including next-generation information technologies such as network communication, blockchain, artificial intelligence, video game engines, digital twins, virtual reality, cloud computing, and the Internet of Things. Against the backdrop of China' s vigorous deployment of new infrastructure, development of the digital economy, and promotion of urban informatization and industrial intelligence, the metaverse industry has received policy support and various supporting resources. The core technologies underpinning the metaverse are expected to achieve breakthrough innovations, making it highly probable that the metaverse will move from concept to reality. Facing the potential arrival of the "metaverse era" and the revolutionary technological changes behind it, there is an urgent need to contemplate the technological environment and social ecology in which journalism operates, to multi-dimensionally assess the potential impacts of the "metaverse" and its derivative technologies on the journalism industry, and thereby to form cognitions and judgments about future development trends and industrial prospects [7]. For journalism and communication studies, the connotation and extension of "space" continue to evolve with the rise of the new technological revolution represented by the "metaverse" and the practical development of media technology, pushing the discussion of the relationship between journalism and space to the forefront.

2. Locating Physical Space: Location-Based News

As early as 2012, Dr. Amy Schmitz Weiss explored the practice of spatial journalism based on location data. Under her leadership, journalism students collaborated with computer science students to develop a mobile news application called "AztecCast," which used geolocation technology to provide information based on students' locations on campus. For instance, students could view news events for any given day while standing in front of academic buildings or music halls.

With the popularization of smartphones, mobile positioning functions based on physical location have become increasingly indispensable in people' s daily lives, work, travel, and entertainment activities. Alongside the development of big data technologies, tracking mobile trajectories and establishing relationship graphs are no longer difficult tasks. If users consent to authorization, China' s three major telecom operators—China Unicom, China Mobile, and China Telecom—can effectively determine mobile phone locations using base station positioning technology. If mobile users enable the "location services" function in their settings, mobile apps can also obtain user location information through GPS, mobile operator base stations, and MAC address tables of Wi-Fi access points. Many apps require location information to provide services: mapping, ride-hailing, and bike-sharing apps offer mobility services; e-commerce and food

delivery platforms conduct deliveries based on location; and travel, social media, news, and weather apps provide local messages or nearby information.

By combining mobile users' location data, algorithms can accurately infer users' residential locations, workplaces, travel destinations, content consumption behaviors, social relationships, and vertical interest characteristics, deeply mining explicitly disclosed or implicitly presented content preferences to discover community affiliations and relational features. Using geofencing technology, it is also possible to identify populations near specific geographical locations and send them targeted information.

Numerous domestic and international news and information mobile apps have already integrated users' geographical location data into their information push functions, using "geographical location" as a trigger element for news reporting and distribution. For example, NBC' s Breaking News app requests location information during installation, allowing users to select the "major events nearby" option to receive news about their immediate surroundings. *Toutiao* leverages its precise geographical location pop-up push technology not only to deliver local news to users but also to provide public welfare news services, pushing information about missing elderly individuals, children, and people with intellectual or mental disabilities to populations near the locations where they went missing. Social media platforms such as Facebook, Twitter, and Sina Weibo have also launched local service functions, including recommending nearby restaurants and transportation information and pushing news updates based on geographical location.

Since the beginning of 2020, the COVID-19 pandemic has raged globally, making location-based news services more important than ever. Audiences have paid greater attention than ever before to news about their communities, streets, and cities—such as local COVID case numbers, risk levels, prevention policies, nucleic acid testing site locations, and traffic control measures—further driving the development of spatial journalism practices. News media have adopted spatial thinking, combining geolocation, digital maps, and dynamic maps to provide audiences with more intuitive information.

During the pandemic, case trajectories have been located through GPS technology within layered urban information networks. By importing this real-time data into digital maps and analyzing it with AI algorithms, real-time pandemic information maps can be created. In early 2020, Johns Hopkins University produced the "Global COVID-19 Spread Map," integrating pandemic data from the World Health Organization, the U.S. Centers for Disease Control and Prevention, the European CDC, Worldometers.info, U.S. state and local health departments, and China' s National Health Commission. Users could click on the world map on the webpage to view the pandemic development status in each region. In the early stages, map data collection was conducted entirely manually, published twice daily. As the pandemic developed, semi-automated real-time data streams were added, updating every 20 minutes. After its release, the map quickly became popular worldwide, with media outlets in many coun-

tries, including the United States, citing Johns Hopkins' real-time data in their COVID-19 coverage. By April 2020, the "Global COVID-19 Spread Map" was receiving over 1 billion daily page views.

Yicai' s Business Data Center developed an epidemic map query tool that, with user consent, automatically locates the user's position and immediately provides the pandemic situation in their location. Specific information includes the number of confirmed cases in the user' s city, nearby streets and communities with reported cases, the number of cases within 1 km and 3 km, and the distance between cases and the user [8]. Using this automatically updated customized map, users can quickly assess the pandemic situation around them and adjust their daily life decisions accordingly, avoiding locations involved in outbreaks when traveling.

In April 2022, when the epidemic caused by the Omicron variant fermented in Beijing, the editorial team of "Dijunhui" used maps to reconstruct Beijing' s infection chain based on the flow investigation information of infected individuals announced at Beijing' s COVID-19 prevention and control press conferences, while simultaneously organizing the data on the spatial data collaboration platform Maptable [9].

3. Reconstructing Space: From Video News 2.0 to Immersive Journalism

Media technology is a crucial factor influencing news authenticity. Each media innovation may bring more vivid, realistic, and persuasive modes of expression, affecting audiences'cognition and judgment of reality [10]. From text and images to video and virtual reality (VR), the journalistic pursuit of reaching the scene and restoring truth remains constant. When hot events occur, the ability of news media to more authentically present the on-site space to readers—minimizing the "gap" between the physical space and the report—brings readers closer to the truth, which remains one of the ultimate goals of news media.

With continuous deepening of visualization technologies, the concept of video reporting has further evolved from Video 1.0' s simple shooting, editing, and forwarding of news scenes to Video 2.0' s comprehensive use of various technologies to provide more complete and diverse dynamic visual coverage of events. This approach fully utilizes spatial dimensions for narrative purposes, using spatial transformation angles to guide story development and filling news scenes with more details.

The Washington Post is a pioneer in video news reform. In September 2020, its video department established a visual forensics team where video journalists collaborate with graphic designers and technical workers to use image forensics technology and digital modeling technology to reconstruct news event scenes, employing spatial narrative to more comprehensively present facts, data, and causes behind videos. In January 2021, when the U.S. Capitol was violently

breached and besieged by rioters, *The Washington Post* released a 14-minute-27-second video report that used facial recognition technology, 3D modeling technology, and combined publicly available maps, on-site videos, and eyewitness interviews to reconstruct the event process and reveal various details of the scene. Synchronized presentation of a bird' s-eye view of the news event location alongside video clips allows audiences to receive more authentic information about the time and space where the news occurred while also sensing the tense atmosphere of the moment.

With the development of Virtual Reality (VR) technology, immersive journalism has further reduced the spatial distance between the scene and the audience to "zero." VR technology is a form of technology built upon computer simulation and immersive multimedia, characterized by highly realistic simulation of real-world situations. Through VR headsets (VR glasses, helmets, haptic suits, space capsules, etc.), audiences can experience firsthand the time and space in which they cannot physically be present and even interact with them. Since 2012, new immersive VR technologies have continuously broken through, and relevant experimental ecosystems have emerged. News organizations such as the Associated Press, *The New York Times*, *USA Today*, *The Huffington Post*, the BBC, and *The Guardian* have all experimented with using VR technology to report news. This immersive journalism makes audiences feel as if they are in the time and space of news scenes, observing on-site events from a first-person perspective, reducing "information attenuation" during the reporting process and thereby amplifying the psychological impact of news events on users.

The New York Times has been at the forefront of VR news production, establishing the "the Daily 360" column in 2016, deploying hundreds of 360-degree panoramic cameras worldwide and training hundreds of journalists. The VR content produced by *The New York Times* covers a wide range of topics, including international news, sports, technology, health, and travel. In September 2019, when Hurricane Dorian struck the Bahamas, the visual news team of *The New York Times* collected information and aerially photographed hundreds of images after the disaster, documenting the scenes of local shantytowns destroyed by the hurricane, and used technology to construct a shocking 3D disaster scene viewable with VR equipment. *The New York Times* employed environmental photogrammetry technology developed jointly with tech companies to record large and complex spaces in 3D form and created interactive models, providing audiences with an immersive experience [11].

In 2017, CNN launched its own immersive news platform "CNNVR." The BBC established its VR program production department "VR Hub"in 2018, producing a series of high-quality VR documentaries such as *Damming the Nile* and *Congo*, as well as the VR comedy short *Nothing Beats a Good Story*. Domestic media' s immersive reporting is also common. For example, in 2020, CCTV.com used drones and panoramic cameras to produce the "*Epidemic Frontline VR Reports*" series, extending VR panoramic reach into various scenes in Wuhan' s epidemic area, allowing audiences to experience firsthand the persistence and dedication

of doctors, traffic police, delivery drivers, and volunteers in this epidemic defense battle and to empathize with them. At the 2022 Beijing Winter Olympics, VR live streaming and immersive journalism were also prominent. For instance, the Yangshipin app launched a VR version, enabling audiences to use VR headsets to watch 8K high-definition curling, ice hockey, and other events for free, totaling 19 competition days and approximately 569 matches, providing audiences with a real-time online, panoramic immersive viewing mode.

4. The Superimposition and Fusion of Real and Virtual Spaces: More Diverse Spatial Experiences

The new generation of information technology innovations centered on digitalization, networking, and intelligence is triggering scientific and industrial revolutions with greater speed, broader scope, and deeper intensity, profoundly transforming social thinking structures and people' s behavioral patterns and causing the boundaries between reality and the network to continuously blur and disappear. It can be said that the superimposition of real space and virtual space has become the norm in people' s lives. With the proposal of concepts such as the "metaverse" and "holographic internet," and the popularization of high technologies including 5G, blockchain, the Internet of Things, artificial intelligence, virtual reality, and neural networks, future virtual spaces will be more immersive, intelligent, interactive, and trans-spatiotemporal.

For news media, how to attempt to fuse real space and virtual space in news products, enhance audience sensory experiences, deepen understanding of events, and achieve cross-spatiotemporal empathy has become a new proposition for spatial journalism practice.

If Virtual Reality (VR) immerses people in a completely virtual environment, and Augmented Reality (AR) overlays digital virtual elements onto the real world, then Extended Reality (XR) refers to an environment combining real and virtual elements with human-computer interaction produced through computer technology and wearable devices, including various forms such as VR, AR, and Mixed Reality (MR). In recent years, media audiences' demand for XR content has gradually increased: on the one hand, due to the pandemic, offline experiences are being rapidly moved online, and XR-related technologies are being widely applied to create more realistic online experience scenarios; on the other hand, the diversification of user needs is also driving the upgrading of experience scenarios, such as achieving virtual imaging performing alongside live broadcast scenes to create immersive stage effects that blend virtual and real elements.

Media institutions are increasingly using XR technology to innovate content works, superimposing real space and virtual space to achieve both immersive interactivity and spatial proximity. During the March 2022 National Two Sessions, NPC delegate Wang Yaping, who was on a space mission, could not attend the meeting in person. To interview her, Xinhua' s Intelligent Editorial Depart-

ment used innovative technologies such as Extended Reality (XR) and virtual space to "teleport" the Xinhua anchor from the new cubic intelligent studio to the Chinese Space Station in the vastness of space, conducting a dialogue across time and space with Wang Yaping, achieving the fusion of real people and digital environments and presenting audiences with a "full real-scene, true screen-integrated" effect [12].

The 2022 Mid-Autumn Festival galas, including Henan Satellite TV's *2022 Mid-Autumn Fantastic Journey*, China Media Group's *Ancient Rhymes, New Sounds*, Dragon TV's *Moonlight East · Mid-Autumn Camping*, and Jiangsu TV's *2022 Jiangsu Mid-Autumn Opera Gala*, all employed XR, 8K, AI, and other technologies to blend historical and modern, virtual and real, natural and technological scenes, creating visual feasts that seemed to traverse time and space and achieving a sense of presence and immersive experience.

The development of virtual human technology has also injected new "soul" into this multi-dimensional fusion of reality and virtuality. Virtual humans have no physical entity and exist in the digital world, created through computer means such as artificial intelligence, graphic rendering, computer modeling, motion capture, deep learning, and voice synthesis, possessing various human characteristics including appearance, language style, and personality traits. With the maturation of intelligent interaction technology, virtual humans can learn autonomously and interact with users through voice, text feedback, and other methods. In the media field, virtual humans are used to host events, broadcast news, conduct interviews, provide real-time translation, and interact with audiences.

Virtual digital humans connect the virtual and the real, with technology embodying itself in the information communication process. In future scenarios, "cross-species" and "human-machine fusion" communication will be realized, completely breaking the temporal and spatial boundaries between virtual and real [13]. Integrating virtual humans into real spaces such as news scenes, sports events, and large-scale activities on the one hand brings audiences novel experiences combining virtual and real elements, and on the other hand can replace humans in completing certain specific tasks. Representatives include SMG (Shanghai Media Group)' s virtual news anchor "Shen Xiaoya," *People' s Daily*' s virtual anchor "Guoguo," Hunan Satellite TV' s digital host "Xiaoyang," and Tencent News' s talk show virtual human "Mei Setian."

In June 2021, Xinhua's Media Convergence Production Technology and Systems National Key Laboratory, in collaboration with Tencent Interactive Entertainment's NExT Studios, jointly created "Xiao Zheng," who serves as both a digital journalist and digital taikonaut. Through real-time high-fidelity digital human technology, "Xiao Zheng" has conducted diverse reporting across multiple virtual-real integrated digital environments, from space to ground, in scenarios such as manned spaceflight engineering and deep space exploration projects. During the 2022 Beijing Winter Olympics, Baidu Intelligent Cloud Xiling created an AI sign language virtual anchor for CCTV News, providing accurate, natural,

and fluent real-time sign language translation and broadcasting services for the hearing-impaired community.

Spatial journalism offers new perspectives on the definition of journalism and communication. For instance, news authenticity is no longer limited to concrete, physical space but will incorporate elements of relational space and virtual space, merging physical authenticity with virtual authenticity [14]. For news media, new technologies have influenced news production and processing methods, prompting journalists to master various application technologies and engage in all-media, multi-dimensional, and three-dimensional reporting, thereby endowing spatial journalism with the possibility of moving from theory to practice.

From the perspective of physical space, location-based news satisfies people' s psychological, cultural, lifestyle, and professional needs for local information. From the viewpoint of using technological means to reconstruct space and restore news scenes, the upgrading of video technologies and methods, along with the development of immersive journalism, further narrows the "gap" between news events and audience senses, making audiences feel as if they are on the scene. As media further shift toward the fusion of virtual and real spaces, accompanied by the evolution of the new generation of internet, this will ultimately influence journalists' and audiences' self-perception, relationship with the world, and information reception methods, promoting future transformations in the journalism industry.

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Note: Figure translations are in progress. See original paper for figures.