DSI DATA SCIENCE AND INFORMETRICS
VOL.3, NO.2, MAY. 2023

RESEARCH ARTICLE

Digital humanities affect: The evolution and revolution of spatial information organization in science fiction

Guohu Lin*

Hangzhou Dianzi University, School of Foreign Studies, Hangzhou, China

ABSTRACT

The spatial information of literature refers to the representation of physical or conscious space in literary works, including position, shape, structure, features, and relationships. The spatial information organization and its method are essential to the whole process of literature production, circulation, acceptance, and reproduction, which is conducive to a deeper exploration of the aesthetic essence of literature in the information era. Taking the organization of spatial information in science fiction as an example, this paper investigates the way of interaction between informatics and literature, explores the function of spatial information in the narrative of science fiction, and discovers digital humanistic laws of literary information organization. This study finds that the spatial information of early science fiction is organized in horizontal, vertical, axial, and causal modes; in the era of digital humanities, influenced by information technology such as the internet, virtual reality, and artificial intelligence, literary space has experienced revolutions characteristic of time-space integration, boundary dissolution, dimensional change, and virtualization; the spatial information organization of contemporary science fiction adopts nested, reticulated, parallel, interactive, and reverse patterns; on the whole, it is featured with fluidity, chaos, correlation, and mutation, creating a unique digital humanistic spectacle.

KEYWORDS

Digital humanities; Science fiction; Spatial information; Organization patterns; Organization features

1 Introduction

Spatial information reflects the distribution characteristics of geographical entities, including the location, shape, size, structure, time, and relationship (Wang & Wang, 2022). Spatial information organization functions in different roles in various fields and constantly adopts theories and methods of related disciplines (Li et al., 2017). Since literary texts are composed of information including data, images, facts, and knowledge, there is no unbreakable barrier between informatics and literature. Traditionally, physical space acts as the background and foundation of literary narration, which enhances the scene construction, theme expression, and image shaping. Spatial information in literary texts transformed, transmitted and stored

* Corresponding Author: alexlingh@hotmail.com

among writers, readers, and markets promotes the development of spatial informatics.

Since the second half of the 20th century, information science, artificial intelligence, and digitalization have promoted the revolution of space theory, and space turn has become an important trend in literary research. Literary space is no longer static and fixed, but relative, dynamic, and emotional, and gradually participates in the construction of meaning, which has profound social, political, and ethical implications. Science fiction, which attaches importance to spatial description, takes spatial form as a structural factor, and explores the spatial function and expression, which sets off a revolution in the development, construction and reproduction of literary space. It also explores the relationship between literary aesthetics and spatial expression pioneeringly and changes the way how writers observe and represent space. However, how does the development of digital humanities influence the spatial revolution of science fiction? What are the internal relations between literary activities and information science? Does the spatial revolution feature unique digital humanistic laws? Taking the evolution of spatial information organization in science fiction as an example, this paper studies the change, structure and law of its spatial information organization, investigates the interaction between informatics and literature within the context of digital humanities, and analyses the function and features of informatics in the field of literature.

2 Spatial information organization and its function in science fiction

Since its birth in the early 19th century, science fiction has drawn on its imagination around exploration of global shape, the inner world, outer planets and a parallel universe. Compared with characters, plots, and narration, science fiction writers are more inclined to depict alien worlds, and spatial information organization is characteristic of unique cognitive ways and philosophical concepts. Traditionally, the representation of literary spatial information in science fiction mainly follows the horizontal, vertical, axial, and causal methods.

2.1 Horizontal mode

The horizontal mode organizes and arranges spatial information based on the synchronic dimension concerning the emergence and development of space. This mode stresses the ordering of spatial concepts, records, and entities in the narrative background of literary works. Science fiction involves the description of numerous spaces, including the universe, planets, earth, cities, landscapes, and others. The writers need to organize information of these spaces according to the sequence of composition and layout, namely with the order of up-down, left-right, and front-back, to present spaces and their relationship to readers synchronically and horizontally.

In many of his space travel novels, Jules Verne uses the horizontal mode to describe physical spaces like oceans, continents and sky, and fictional spaces including geocenter, cosmos, machine, and utopia. *Twenty Thousand Leagues Under the Sea* (1871) shifts the narrative setting to the unfamiliar seabed, and the underwater world is an independent system with numerous treasures and magnificent scenery. In *Around the World in Eighty Days* (1872), the organization of literary space is a patchwork, with specific locations, positioning, traffic routes and others, just like a reliable investigation report which contains many objective geographical data. Curd Lasswitz also depicts the space landscape step by step in his works. In his *Two Planets* (1897), the author arranges spatial information, such as the crisscrossing

canals on Mars and traffic routes between Mars and the Earth, using a horizontal method. In Edwin Lester Arnold's *Gulliver of Mars* (1905), Edgar Rice Burroughs' *John Carter of Mars* (1912), Arthur Conan Doyle's *The Lost World* (1912) and other works about fantastic travel, the spatial information functions as media and guides readers to imagine the unknown fields in the infinite expanse of the universe.

The horizontal mode takes the physical layout as the structural unit to construct the space, adopts a large number of scattered and disorderly data, images and descriptions, and forms a system that is convenient for effective utilization after being sorted and optimized. The method outlines the overall situation of the horizontal layout of literary space from a macro perspective. Simultaneously, it makes necessary descriptions of its details to facilitate the synchronic analysis of spatial nature, structure, and relationships.

2.2 Vertical mode

The vertical method of information organization focuses on the time scale of change and development in spaces. Often used in the information organization of historical documents like yearbooks, memorabilia, and historical chronologies, the vertical organization of literary spatial information takes the time sequence of the same space as its logic. It moves forward in the form of time evolution. It describes the process of a specific space's evolution by observing and comparing spatial changes. Using time as the axis helps to understand the nature and laws of the entire process of spatial evolution.

Time-travel science fiction most evidently employs the vertical method. In *A Connecticut Yankee in King Arthur's Court* (1889), Mark Twain directly compares the spatial landscape of 19th-century Connecticut with 6th-century Arthurian England through the plot of time travel. The time traveler in H. G. Wells' *The Time Machine* (1895) freely moves into the past and future. With the time machine in the London suburb as the center, information on spatial evolution—including natural landscapes, city construction, and human-made spectacles spanning 30 million years—appears vividly before readers. This fiction inspires subsequent time-travel science fiction works like Karl Alexander's *After Time* (1979), Robert A. Heinlein's *All You Zombies* (1959), and Robert Silverberg's *Absolutely Inflexible* (1956). Another subgenre of science fiction with a vertical information organization structure is future fantasy, which explores the future world. Although the background is set directly in the future without any time-travel plot, writers can still compare the future world with their contemporary space. H. G. Wells' *Men Like Gods* (1923) aims to compare the future space under totalitarianism with the world of the 1920s. In *The First Men in the Moon* (1901), describing the Moon without prior knowledge of spatial information about the Earth would be impossible.

The vertical method operates according to the time sequence of spatial change and development, necessitating a keen sense of time among writers and readers. The writer's attitudes toward space become clear by recording and observing spatial evolution in different periods. However, the vertical structure of science fiction only sometimes follows a chronological order. Narrative techniques like flashbacks and interpolations are vertical variants of this information organization structure.

2.3 Axial structure

Axial structure relies on the mutual reference and communication between internal and external information of a space. Literary texts describe two interrelated but different spaces, the external physical world and the inner consciousness. External information, extending

from and reflecting the internal core, follows internal logic and law for its organization. The axial organization mode in science fiction stresses the internal logic, and only through it can readers understand the spatial composition and essence of the works.

While science fiction focuses on external space, addressing the relationship between physical world and the writer's consciousness remains essential. In Isaac Asimov's *The Foundation Series*, the Galactic Empire spans 100,000 light-years of countless desolate planets and rules over 25 million inhabited planets. However, this soaring spatial expansion can find its logical root in the chief mathematician Hari Seldon's psychology, enabling him to deduce all humankind's development and trend with mathematical formulas. In C. S. Lewis' *The Space Trilogy* including *Out of the Silent Planet* (1938), *Perelandra* (1943), and *That Hideous Strength* (1945), the solar system has a deep spiritual system, and thus each world is mutually connected. The writer and his friends are regarded as prototypes of the main character Dr. Elwin Ransom (Gumerova & Sergeeva, 2022). In *Consider Her Ways* (1956) by Frederick Philip Grove and *Animal Farm* (1945) by George Orwell, animals' living spaces are metaphors for the externalization of the writers' inner consciousness, unveiling the political crisis and social turmoil of the human world.

J. G. Ballard once put forward the concept of "inner space" which refers to the intersection between conscious and physical spaces, to describe the complicated relationship between the inner world of human beings and the natural world (Mayo, 2020). As a social consciousness, literary writing reflects reality and presents the significance and value of human existence through literary language, which is primarily internal reference. The axial organization mode marks the strength and necessity of mutual reference between writers' consciousness and reality.

2.4 Causality

The causal method of information organization relies on causality logic, emphasizing the inevitable connection between cause and result. The organization of literary spatial information is carried out according to the causal relationships and stresses the temporal and spatial integrity. In traditional science fiction, the relatively limited spatial information leads authors to establish causality as the relationship between spaces primarily. Spatial development must have its reasons, and one spatial information will inevitably affect another result information.

Causality is the motive force of science fiction narration, whether it is vertical or horizontal narrative. It pursues complete structural integrity with interlocking plots and strict logics. This way of information organization is particularly prominent in dystopian science fiction. The spaces in *Nineteen Eighty-Four* (1949), *Brave New World* (1931) and *We* (1924) are full of modern facilities like high-tech sports ground, rooms and offices optimized by scientific and technological products, advanced laboratories, and convenient traffic. However, the spatial information reveals that war, totalitarian politics, and extreme rationality in the future world results in a world of terror, depression, and disaster. The destruction of humanity and the Earth in H. G. Wells' *The War in the Air* (1908) and John Wyndham's *The Chrysalids* (1955) urges readers to think about the causes of disasters through space depiction. In Wells' *The War of the Worlds* (1898), and Kurt Vonnegut's *Cat's Cradle* (1963), the authors aim to reveal reasons behind the profound change in space, such as climate change, astronomy, unnatural disaster, and disease. They also critique scientists who lack humanistic care and moral consciousness.

Space is not an isolated object in itself, and the existence and development of space have

their causes. Science fiction writers explore alien spaces and attract readers through fantastic imagination. In addition to entertainment, they represent social functions of reflecting the status quo and proposing improvement plans, which have profound practical significance. By starting with causal logic, authors can organize seemingly complex and fantastic spatial information, allowing readers to understand the emergence, composition, and changes of literary space and perceive the space's social, cultural, historical, and political background.

3 Digital humanities and spatial revolution in science fiction

In the second half of the 20th century, human society gradually moves from the industrial age to the digital age, driven by technology such as informatics, cybernetics, and bionic machinery (Kopec, 2016). A significant change has occurred in time and space, breaking the original spatial pattern of order, accuracy and systematicness (Moloney et al., 2019). This spatial revolution triggers the space exploration of New Wave, cyberpunk and other science fiction subgenres. Taking information technology as the theme, writers depict the living space of human beings, imagine the prospect of information technology and consider the relationship between scientific progress and space construction, which consists of the following essential characteristics.

3.1 Space–time integration

Space-time refers to the integration of time and space through external force. According to Einstein, space is a flexible concept inseparable from and intertwined with time. The space-time redefines the mechanism of time and space, finds reliable scientific evidence for the spatial fantasy of traditional science fiction, and inspires a more complex space revolution. Space-time integration is an important feature of the spatial information of science fiction in the digital humanistic era. Since then, space exploration in science fiction has become bolder and more profound, triggering readers' multiple imaginations.

The integration of time and space provides a scientific and theoretical basis for space travel, time travel, time compression, space folding, time manipulation, and space crossing in science fiction. Contemporary science fiction further explores space, completely breaking the shackles of linear time and space. Super-light-speed travel and time travel in *Star Wars* achieve space-time integration by distorting time and space. In Frank Herbert's *Dune* (1965), it is through the folding of time and space that the aerospace trade union monopolizes the navigation of the planet and transmits the overhead spacecraft out of the Milky Way. In Madeleine L'Engle's A *Wrinkle in Time* (1962), the protagonist shuttles through time and space, crosses five-dimensional space, and rescues the imprisoned scientist father from the planet of Camazotz. Keith Lanson, the captain in Robert Sawyer's *Starplex* (1996), flies away from the starship and goes to the human base to offer help, but he gets lost halfway and strays into another time and space. In this time and space, human intelligence with eternal life sends a group of stars back to the space where human beings live.

3.2 Boundary dissolution

In the late 20th century, spatial turn aroused by space production theory and proposed by Henry Lefebvre, Michel Foucault, Edward Soja and others became a trend. Spatial construction eliminates the shackles of traditional conception and is characteristic of diversification, heterogeneity, and interdisciplinary (Bologna, 2020). Space refers to geographical or physical

landscape and spiritual fields such as culture, history and religion, containing information on cultural practice, representation and imagination (Lefebvre, 1991). By combining science, humanities and imagination more deeply, science fiction introduces a more excellent range of topics in politics, psychology, society, and philosophy, ultimately bringing it closer to mainstream culture.

In *Genocidal Organ* (2007) by Project Itoh, literary space comprises cross-border integration and interweaving of language, physics, and psychology, which is multi-levelled and has become a new methodology to participate in literary construction. Arthur Clarke's *2001: A Space Odyssey* (1968), Isaac Asimov's *I, Robot* (1950), and Robert Heinlein's *The Moon Is a Harsh Mistress* (1966) present readers with the future world in which technology greatly transforms space, and robots participate in space construction. Kim Stanley Robinson's masterpiece the Mars trilogy, including *Red Mars* (1992), *Green Mars* (1993), and *Blue Mars* (1996), no longer attract readers by the geographical landscape but pay attention to philosophy, politics, religion and humanity of human immigrants' living space in Mars. Cormac McCarthy's novel *The Road* (2006) contains multiple metaphors in the grotesque image world, and its spatial ambiguity and cross-border existence are very obvious. Ursula Lequin's *The Left Hand of Darkness* (1969) portrays a winter star and a hermaphrodite Gesen with extreme climate and blunt survival. Its fundamental purpose is to explore issues such as gender, society, and life in modern society through space construction.

3.3 Dimensional change

The physical space is three-dimensional. Three measures exist, including length, width, and height, and one can express movement in any other direction using just these three. The spatial dimension revolution in the digital humanistic era is not a spatial leap from the ground to the ocean, the geocenter, or the outer space, but an increase and decrease in the number of spatial dimensions. In *The Time Machine*, space has become a four-dimensional dynamic space because of the addition of the time axis, which makes time travel possible. In *Flat Land*: *A Romance of Many Dimensions* (1884), the protagonist is a square living in a two-dimensional flat country who leads readers to travel to spaces with different dimensions. More than a century later, the revolution of spatial dimension is broader and more thorough. Ian Stewart's *Flatterland* (2001), the sequel to Flat Land, is a dimensional experiment in the digital age. The protagonist Vikki scans herself into the computer and moves between Flatland and Spaceland with Space Hopper. They travel to various spaces in the Mathiverse. In *The Three-Body Problem* (2008), Liu Cixin makes bold artistic guesses and elaborations on the world beyond three dimensions and deduces the rules about the increase and decrease of dimensions. With the increase of dimensions, the structural complexity of particles increases sharply, and observing particles from different dimensions, their internal structures are vastly different. Dual vector foil is a weapon of universal law in the novel, which can reduce the dimension and turn any dimensional world into a strange two-dimensional space. An eleven-dimensional world appears in the film *Interstellar* (2014). In *The Number of the Beast* (1980), Robert Heinlein depicts a six-dimensional universe.

3.4 Virtualization

Information technology has created virtual reality comprising digital signals, simulation, and connection. Human society has expanded from the physical world to the virtual space, presenting a dualistic social existence form in which virtuality and reality coexist and con-

structing a new field of behavior activities for human survival and development (Giraud, 2015). The cognition of reality is undergoing a new change of integrity and structure at the fundamental level of space. Virtual reality blurs the boundary between reality and fiction. In particular, the emergence of meta-universe where physical entities and digital objects coexist has caused philosophical and ethical confusion in human feelings about spatial reality (Rospigliosi, 2022).

The New Wave science fiction and cyberpunk forecast the emergence of psychological space-time and cyberspace. William Gibson proposes the concept of cyberspace and defines it as a computer-generated landscape, a virtual space of the global computer network connecting all people, computers and various information sources in the world (Kellerman, 2007). In the cyberspace, taking *Neuromancer* (1984) as an example, the binary boundary between human beings and space is gradually melting, and human beings' self-awareness has awakened and evolved into cyberspace subjectivity. Cyberspace bears the construction of virtual identity and the imagination of Itobong (Wang, 2020). The meta-universe in Neal Stephenson's *Snow Crash* (1992) is a virtual digital space consisting of digital twins of people, places, and things. The urban space and cyberspace metaphors in cyberpunk show the characteristics of natural disintegration, diversification, and intelligence.

4 New patterns of spatial information organization in science fiction

In the era of information, colossal change brought by digital technology has led to the disintegration of conventional spatial concepts. Literary space has become an open system with broader information sources and organization mechanisms. Science fiction writers represent reality from various perspectives, which makes the literary space construction more complex and diverse. However, no matter how messy, complex, and changeable the space is, the structure of spatial information could be discerned. In contemporary science fiction, there emerge several new organization patterns.

4.1 Nested structure

Nested structure, also known as the structure within the structure, is first adopted in literary narration, in which more stories derive from a story, forming an interconnected structure like Russian dolls. It has become a structural way to deal with time and space in science fiction. With this kind of nesting, one space crosses another space, and one dimension leads to another, thus creating a special spatial information organization pattern.

In *Paprika* (1993) which inspires the spatial embodiment of the film *Inception* (2010), Japanese writer Yasutaka Tsutsui uses this nested structure to create several layers of dreams. The former space provides the possibility for the latter while completing the next level of space also determines the former. The nested structure of space in *The Three-Body Problem* is divided into three levels: exploring Three-body civilization, the main character Ye Wenjie's life experience in the Cultural Revolution, and Ye's memories. These three levels of space are progressive from large to small, which helps readers understand the origin of the creation of the three-body mode. In Daniel F. Galouye's *Simulacron 3* (1964), the protagonist finally finds that the nested world, the "triple simulation", which he thinks is reality, is actually the "virtual reality" of another world. In such a nested organizational pattern, there will be multiple narrators, and each narrator is the protagonist of his own story. David Mitchell's

Cloud Atlas (2004) consisted of six interlinked stories nested inside each other in a Russian doll fashion.

4.2 Reticulated structure

The reticulated structure is characteristic of point-to-point and end-to-end interactive connection. It is like a spider web, different from tree-like, radiative, horizontal, and vertical patterns. This grid-like spatial information organization pattern in literary works has no coherent and unified plot or narrative focus. It comprises fragments that disrupt time and space, but a centripetal force exists between each fragment or mass, forming a loose spatial structure. Although each component's functions differ, they restrict and coordinate with each other, forming a complete functional system and establishing a folded and interactive framework.

Many cyberpunk novels organize spatial information in such a pattern. In his *Snow Crash*, Stephenson depicts a vast virtual world in which people can have their virtual body doubles controlled by digital avatars. This virtual world, meta-universe, is another parallel universe beyond reality, in other words, an artificial virtual world parallel to the real world. In his other work, *The Diamond Age* (1995), the protagonist looks for solutions through remote association, complex decision-making, and cross-domain. William Gibson regards cyberspace as a "consensus illusion," which is a visualization of data on every computer within a globally accessible network (much like the Internet) (Yousif, 2019).

The connections between each spatial information are arbitrary and irregular in the pattern, and no logical or hierarchical relationships exist between them. The networked space based on digital technology breaks the plane connection between space and people and between people and things. Thus decentralization becomes the main feature of the reticulated structure. In the world of Cory Doctorow's *Down and Out in the Magic Kingdom* (2003), Daniel Suarez's *Daemon* (2009), and *Freedom TM* (2010), digital identities of human beings can use technologies such as blockchain, cryptographic algorithms to achieve their goals in the digital reality like their human subjects. In cyberspace, social and cultural existence is transformed into indiscriminate data, thus achieving technical equality for all.

4.3 Parallel structure

Parallel structure is typical in science fiction works in which multiple spaces are equal in shape, nature, and status. Such a structure helps present the large-scale cosmic world described by the theories of general relativity, string theory, and multiple space-time, which has the same natural superiority and effectiveness. One can travel back and forth between multiple parallel worlds or universes, or one can appear in different parallel worlds simultaneously, and multiple identities are the doppelgangers of the same subject in multiple parallel worlds.

In *Sidewise in Time* (1934) by Murray Leinster, the prediction of multi-world theory under quantum mechanics appears. In the open setting, space appears infinite, allowing for free traversal and rebirth. There are two parallel universes in Asimov's *The End of Eternity* (1955), the primitive one and the one outside time called Eternity. People in Eternity are eternal and can travel backward and forward in time. However, their time travel may result in "minimum change", the slightest possible change in history like the butterfly effect. In this way, the two parallel universes are connected. Timothy Zahn's *Cascade Point* (1987) and several other novels set in the same universe assume that the protagonist will simultaneously appear in ghost form in parallel universes. In Robert A. Heinlein's *The Cat Who Walks through Walls* (1985), characters can cross time and travel instantaneously from any point in the

space-time-universe to any other parallel universe.

4.4 Interactive pattern

Interaction pattern refers to the content and structure of communication between two or more interactive individuals who cooperate to achieve a specific goal. Since the digital humanistic era does not isolate space, more interaction occurs between humans and computers, humans and robots, space and people, laying a foundation for the interactive structure. The structure can also achieve hierarchical linkage to a certain extent. In cyberpunk novels, there are a series of new concepts and trends of interaction, such as human beings entering cyberspace and competing for sovereignty with computers, human beings cooperating with programs, and programs having their own consciousness and emotions.

In Ted Chiang's *Story of Your Life* (1998), there is a world without the sequence of time of past-present-future, spaces are synchronically interweaved and interconnected. Ernst Klein describes a virtual reality world in *Ready Player One* (2011), where virtual reality technology and online games perfectly combine. The game company "Oasis" emerges this blend, becoming a haven for people to avoid social interaction and bringing to life the virtual world formed by supercomputing from the real world. The more radical interaction is that human beings enter cyberspace to interact with computers. Discussing the link between human brain and computer, many works, including *Neuromancer*, Bruce Sterling's *Schismatrix* (1985), and John Shirley's *Eclipse* (1985), tell stories about how computer cowboys connect themselves with the computer and allow their mind leave bodies and explore in cyberspace. In Orson Scott Card's *Ender's Game* (1985), children think they are playing video games, but in fact, they are participating in the star wars from a far distance. In order to resist the attack of alien zerg, human beings set up an international fleet, and children are trained from the age of 6 to find a way to destroy the entire alien invader species by playing computer games.

4.5 Reverse structure

The reverse structure refers to the filliped collocation and arrangement of spatial information. In literary works, the ordinary structure of space has been deliberately changed in a powerful way to create a shocking visual effect. Upside-down worlds in the films *Inception* (2010) and *Upside Down* (2012) are good examples. The reverse structure pursues and creates the fragmentation, superposition, radiation, and interlacing of time and space, characterizing it uniquely.

In Hao Jingfang's *Beijing Folding* (2012), the city of Beijing is divided into three spaces, with people of different social classes living in separate and isolated spaces. At the time of conversion, the residents of the previous space need to lie on the bed for hypnosis, and the buildings and other facilities of the previous space fold up, and the buildings of the next space unfold. Exploration of other dimensions also occurs in William Sleator's *The Boy Who Reversed Himself* (1986). A weird boy can enter the fourth dimension and launch a journey into the new space. The exploration and discovery of the "outward-facing" symbolized by the spacecraft has shown a trend of "turning inward". In William Gibson's novels, human beings have gradually become cyberized; chip implantation, morphological plastic surgery, and genetic modification have become standard technologies that enable human beings to transplant and transform limbs and organs quickly. The reverse structure also reveals itself in exploring the micro-world with miniaturization technology. Asimov's *Fantastic Voyage* (1966)

is the first to shoot the inside of the human body with miniature technology. In the story, a group of American doctors is miniaturized to one millionth, about the size of a microbe, and injected into a scientist's body to perform vascular surgery.

5 Features of spatial information organization in the digital humanistic era

The rapid development of digital technology subverts the way people live and think. At the same time, the development of literature also needs a new model as a starting point to find a suitable posture. The spatial information organization of science fiction presents four features including fluidity, chaos, relevance, and mutation, which also can be applied to information organization in other literary genres in the digital humanistic era.

5.1 Fluidity

In the era of digital humanities, literary space does not exist as a passive static state; instead, people view it as a vivid force (Gomel, 2014). It comprises discourses, factors, and practice from various fields, including sociology, history, economics, and cultural studies. Literary space undergoes constantly reproduction, as a two-way effect exists between the writer and the literary space. Thus fluidity has become a valuable perspective to understand the increasingly complex literary space. Reality affects the creative subject and then implements it in literary creation, reflecting the subjective initiative of the writing subject and that the literary space has elements of fiction and an adequate imagination. Social reality and the human inner world are less intuitive than classical science fiction. Spatial information in literature bids farewell to the traditional characteristics of stability, regularity, integrity, and systematicness and presents the characteristics of dynamic mobility. Whether using the standard spatial integration mode of science fiction, such as nesting, blockchain, and interaction, or other modes of contemporary fiction, writers no longer expect a fixed space as the foundation. The expansion, production, and end of space are also typical. This dynamic information organization has also changed the way of literary aesthetics and promoted the evolution of the whole thinking in the direction of digital humanism.

5.2 Chaos

In the age of artificial intelligence and digital information, uncertainty replaces certainty, and chaos emerges as the main principle. Chaos embodies a method that incorporates both qualitative thinking and quantitative analysis to discuss behavior that a single data relationship cannot explain or predict; instead, it requires explanation and prediction through a whole and continuous data relationship in a dynamic system (Ragin, 2000). Chaos does not receive treatment as a disorder or a lack of determination but rather as a changing process encompassing the birth and disappearance of being. The absolute accuracy of the information is impossible, and spatial information is no longer linear and logical but pluralistic and diverse. There is no essential difference between scenes in physical world in science fiction and virtual reality. In cyborg science fiction novels, authors often set the background of the times shortly after the high development of computers and information technology, when the boundaries between people, machines, and artificial intelligence become blurred. In *Greenhouse Summer* (1999) by Norman Spinrad, the post-national world has become chaotic. In the biosphere, flood waters have submerged many continents due to the ice caps melt-

ing.

5.3 Correlation

In the era of small data, information is arranged based on causality. Causality emphasizes that cause and result must be related simultaneously, and data will inevitably affect a result (Kathpalia & Nagaraj, 2021). In the digital era, the relationship between spaces no longer has a clear purpose and object; its relationship is not causality but correlation. This connection guarantees and guides the change and development of the organization of spatial arrangement. Parallel universes are no longer causal, but with the discovery of quantum technology, the relationship is mutual and has the characteristics of inaccurate traceability. Vernor Vinge's *True Name* (1981) depicts an entirely immersive virtual reality technology. More importantly, the writer predicts that the appearance of computers will make the communication between individuals or organizations completely anonymous. The internet has developed rapidly since then, and the pace of reality is constantly catching up with Vinge's imagination. The meta-universe has blurred boundaries between reality and fiction, body and machinery, human brain and computer. In William Gibson's *Count Zero* (1986), the character is a "brain in a vat" without body, but with the only a brain and cyberspace, he can wander freely and even control the vast external world.

5.4 Mutability

In the digital age, literature and culture have undergone fundamental changes with turmoil and fission. The literary space is changing, updating and full of contingency, and how writers integrate the information has also changed, characteristic of apparent mutability. Many science fiction novels about disasters describe the drastic changes in space, which are often irreversible and sudden. In Arthur Clark's *The Songs of Distant Earth* (1986), the Earth ends and human beings are faced with two choices: to transport genes to aliens or directly cultivate native humans on other planets by freezing the body of the last generation of earthlings. A similar plot occurs in Liu Cixin's *The Wandering Earth* (2000). Weather to migrate to the new planet or to move the Earth to avoid the disaster of a supernova is a question. The change of space-time, body space and space dimension represents significant mutation for spatial development. In the world described in *The Windup Girl* (2009), there are a series of scenes of mutation. In the near future, genetically modified organisms have almost destroyed the world's ecosystem, petrochemical resources are almost exhausted, the modern civilization based on oil is falling apart, and human society has entered a harsh post-petrochemical era. The world described in *Schismatrix* (1985) is even more disorderly, and the evolution of human beings will develop in the direction of surgery, transplanting organs, and installing artificial limbs to extend human adaptability. KenKen McLeod's *Newton's Wake* (2004) blends cyberpunk, space opera, and post-apocalyptic fantasy, telling the story of the world after the rapture, where artificial intelligence causes a devastating war on the Earth.

6 Conclusion

Digital humanities subvert the inherent structures and essential boundaries of various fields and establish new research methods, knowledge systems, presentation modes, and theoretical frameworks, highlighting information science's humanistic value and providing a new development path and discourse interpretation space for literature. This paper has stud-

ied literary aesthetics from the informatics perspective, discussed the evolution of literary space in science fiction, and analyzed organization patterns and laws of spatial information under the background of digital humanities. The conclusion reveals that the development of digital humanities has triggered a revolution of the concept of space and fostered a change of the integration mode of literary space. This creates new patterns and laws that align with natural science's dynamic and relevant characteristics and aesthetic principles, such as vagueness, chaos, hybridity, and mutation. Although science fiction is at the forefront of the study of space and time, and inspired by latest achievements of science and technology, the construction of literary space and its information organization is marked with particular values and significance, including introspection, nostalgia, sentimentality, and others. In addition, the development of science fiction varies from country to country, and its acceptance cannot compete with other literary genres of the mainstream, which could offer more examples for the study of literary information organization.

References

Bologna, F. (2020). A computational approach to urban space in science fiction. *Journal of Cultural Analytics, 5* (2), 37–60. doi: 10.22148/001c.18120

Giraud, E. (2015). Subjectivity 2.0: Digital technologies, participatory media and communicative capitalism. *Subjectivity, 8*, 124– 146. doi: 10.1057/sub.2015.5

Gomel, E. (2014). *Narrative space and time: Representing impossible topologies in literature. Routledge,* London.

Gumerova, A., & Sergeeva, V. (2022). The historical context of CS Lewis´s Novel "That Hideous Strength". *Linguaculture, 13* (1), 69–80. doi: 10.47743/lincu–2022–1–0234

Kathpalia, A., & Nagaraj, N. (2021). Measuring causality: The science of cause and effect. *Resonance, 26*, 191–210. doi: 10.1007/s12045–021–1119–y

Kellerman, A. (2007). Cyberspace classification and cognition: Information and communications cyberspaces. *Journal of Urban Technology, 14* (3), 5–32. doi: 10.1080/10630730801923110

Kopec, A. (2016). The digital humanities, inc.: Literary criticism and the fate of a profession. *PMLA, 131* (2), 324–339. doi: 10.1632/pmla.2016.131.2.324

Lefebvre, H. (1991). T*he Production of Space* (trans. by D. Nicholson–Smith). Oxford, Blackwell.

Li, D., Shen, X., Chen, N., & Xiao, Z. (2017). Space–based information service in internet plus era. *Science China Information Sciences*, *60*, 1–10. doi: 10.1007/s11432–016–9164–1

Mayo, R. (2020). The myth of dream–hacking and ′inner space´ in science fiction, 1948– 2010. In: Taylor, S.J., Brumby, A. (eds), *Healthy Minds in the Twentieth Century: In and Beyond the Asylum.* Palgrave Macmillan, Cham. doi: 10.1007/978–3–030–27275–3_11

Moloney, R., Fabris, A. L., Staab, D., Frey, A., Garbayo, A., & Shadbolt, L. (2019). Space travel, electric propulsion and science fiction. In *77th World Science Fiction Convention, Dublin.*

Ragin, C. C. (2000). *Fuzzy–set social science*. University of Chicago Press, Chicago.

Rospigliosi, P. (2022). Metaverse or Simulacra? Roblox, Minecraft, Meta and the turn to virtual reality for education, socialisation and work. *Interactive Learning Environments, 30* (1), 1–3. doi: 10.1080/10494820.2022.2022899

Wang, S., & Wang, G. (2022). Research on ubiquitous map information organization oriented to location–based aggregation. *Journal of Geoscience and Environment Protection, 10* (1), 238–249. doi: 10.4236/gep.2022.101016

Wang, Y. (2020). The cyberspace and new life form in the cyberpunk fiction: The case of William Gibson´s Sprawl Trilogy. *Foreign Literature, 3*,15–26. doi: 10.16430/j.cnki.fl.2020.03.003

Yousif, S. R., Aboody, R., & Keil, F. C. (2019). The illusion of consensus: A failure to distinguish between true and false consensus. *Psychological Science, 30*, 1195–1204. doi: 10.1177/0956797619856844