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On the Engineering Turn in Modern Science Fiction Cinema

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Abstract: With the profound advancement of technological development and social transformation, science fiction cinema since the mid-twentieth century has increasingly exhibited a distinct "engineering turn," undergoing significant shifts in both narrative structures and creative mindsets. This marks a transition from early narrative modes reliant on fantastical props and romantic imagination toward a systematic, materialistic narrative paradigm centered on engineering thinking. This study examines this phenomenon through two primary dimensions: "super-apparatus" and "world-building." Through comparative analysis of cases such as *2001: A Space Odyssey* and *The Wandering Earth*, it analyzes how engineering thinking reshapes the visual aesthetics and narrative logic of science fiction cinema, and investigates the underlying sociocultural drivers, including technological imperatives, the evolution of the film industry, and the enhancement of public scientific literacy.

Keywords: Science fiction cinema; Engineering turn; Technology and Society

Introduction

"Science fiction," as a genre, serves as a vital category within literature and art. While its literary origins can be traced variously from the sixteenth to the nineteenth centuries, the seeds of science fiction in cinema germinated alongside the birth of the medium in the early twentieth century. Since Georges Méliès directed *A Trip to the Moon* in 1902, science fiction cinema has been inextricably linked to technological development. Constrained by technical means and contemporary conceptions, early science fiction films often imbued their scientific imagination with strong magical qualities and romantic tendencies, treating technological devices more as enchanted props than functional machinery.

However, since the 1960s—marked specifically by the release of *2001: A Space Odyssey* (1968)—a new trend has emerged. In both visual presentation and narrative logic, science fiction cinema has increasingly pursued expressions grounded in known scientific principles and engineering feasibility, demonstrating a pronounced materialistic orientation. The narrative focus has shifted from early romantic depictions of external spectacles and adventures to philosophical examinations of the logic of technological development, its social consequences, and humanity's position in the universe. The technological themes involved have transitioned from miniaturized, individualized specialized techniques to large-scale, socialized, and comprehensive engineering projects, revealing the distinct imprints of engineering culture. Scientific principles and technical details are no longer merely background elements or embellishments; instead, they have become core elements that drive the plot, shape conflict, and even define humanity. This transformation can be termed the "engineering turn" of modern science fiction cinema.

Therefore, this paper analyzes how engineering thinking reshapes the visual aesthetics and narrative paradigms of science fiction films from the perspectives of "super-apparatus" and "world-building," while exploring the underlying technological and sociocultural motivations. This study aims to examine the evolutionary trajectory of modern science fiction cinema, uncover its developmental patterns, and further expand the depth and breadth of contemporary research in the field.

From Fantastical Props to Feasible Systems: The Visual and Narrative Evolution of "Super-Apparatus"

The "super-apparatus" is a classic visual element in science fiction cinema, typically possessing functions with surrealistic qualities. Films often unfold eccentric or thrilling stories around such inventions. Simultaneously, these devices serve as critical narrative elements in coordination with other science fiction themes—acting as survival or transportation tools in exploration-based works (including space and time travel), or as indicators of technological and civilizational ad-

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vancement on alien worlds. Their narrative function can be traced back to the *deus ex machina* of ancient Greece or the scenographic revolutions since the Renaissance.

In early science fiction films, the dominant mode was a relatively rough "mental-image" expression based on imagining future worlds to satisfy realistic needs, often remaining technically and narratively underdeveloped. The "super-apparatus" in these films tended to be depicted as omnipotent magical props or mysterious, unknowable objects. Examples include the gigantic projectile spacecraft in *A Trip to the Moon*, which enabled a fantastical journey where humans travel to the moon by cannon shell, or the weather-control devices and punitive robots in *Shanghai After Sixty Years* (1938). A shift began in the mid-twentieth century, specifically with Stanley Kubrick's *2001: A Space Odyssey*, which provided unprecedented detailed portrayals of aerospace systems, space stations, and spacesuits. Entering the twenty-first century, the engineering turn has integrated visuals and narratives more tightly, with engineering activity itself becoming the protagonist. In *The Martian* (2015), for instance, the core narrative is a massive survival engineering project: the protagonist must use botany and chemistry to produce water and cultivate potatoes on Mars, while the NASA team on Earth must solve technical challenges for remote rescue.

Underlying these functional changes is a shift in the ontological view of technology. Early films presented technology as a mysterious external force with obscured mechanisms, akin to magic. This approach reflected a view of technology as isolated, unknowable, and controlled by a few. The creation and application of technological achievements carried strong heroic colors, serving primarily to drive a single plot line or create visual spectacle. These features highlighted the mystery of technology and its alienation from the masses. On a craft level, these technologies were difficult for the public to recognize or understand; on an application level, they were untouchable. Filmmakers used this to emphasize the sophistication and rarity of these technologies, thereby serving the romantic atmosphere of the story. Furthermore, as film props, early super devices did not need to reveal internal mechanisms, creating a visual barrier that prevented audience understanding. They often transcended contemporary scientific theory, ignoring the conservation of energy or achieving effortless teleportation. This absolute reliability and surrealism severed any link to the incremental, error-prone technology of the real world.

Compared to science fiction literature, which relies on text to stimulate abstract imagination, the film medium must transform abstract concepts into concrete, perceptible visual images. As technology permeates daily life and public scientific literacy rises, science fiction cinema has moved toward demystification. The maturity of CGI, compositing, and motion capture has expanded the aesthetic space for this. Visual presentation in film possesses a "realistic anchoring," meaning surreal settings must be built upon physical experiences familiar to audiences. Cinema requires visual language to turn abstract logic into perceptible sequences, making the operation or failure of a device a source of dramatic tension. High-level visualization allows audiences to intuitively see the logical chains behind the device—through details of information flow, energy transmission, or mechanical linkage—elevating the device from a static prop to a dynamic narrative force.

Before filming *2001: A Space Odyssey*, production designer Ken Adam was the first choice, but he felt the strict scientific requirements would limit visual creativity. Kubrick, insisting that the design should be done by someone who understood both science and engineering, hired NASA expert Harry Lange and scientist Frederick Ordway as consultants. To realistically simulate centrifugal "artificial gravity" in space, the crew cabin of the *Discovery* spacecraft was designed as a massive rotating structural project. This core set, built by the British Vickers-Armstrong Engineering Group, was a gigantic rotating apparatus costing $750,000 and weighing 30 tons. The device was 38 feet in diameter and 10 feet wide, rotating at 3 miles per hour, with its inner surface fitted with all furnishings. During filming, actors walked at the bottom while the set rotated around them, allowing the screen to present a realistic, technologically sophisticated spaceship.

The subsequent *Wandering Earth* series further advances the narrative integration of "super-apparatus." The "planetary engines" are not merely spectacles but become the core narrative devices driving the story. The film explains the setting through natural dialogue, detailing the global distribution of the engines and their "heavy fusion" mechanism. This realistic shaping of mechanical structures breaks with the traditional fuzzy handling of internal mechanisms, allowing audiences to understand operational logic through visible transmission devices and cooling systems. While the "heavy nuclear fusion" relied upon has not yet been realized, projects like ITER and China's "Artificial Sun" (EAST) have laid the foundation for light nuclear fusion. This resonance between art and reality detaches the device from purely fantastical attributes, rendering it a discussable future systems-engineering project.

This engineering turn stems from an ontological shift in the public's view of technology. Technology is no longer seen as a mysterious set of tools but as a complex, open system constructed with human participation. Consequently, devices in modern films increasingly exhibit inherent fragility, complexity, and deep embedding in social structures. The risks of engineering systems are not only manifested in uncontrollability but also in the damage they cause to human values. Modern narratives often set the "super-apparatus" as a potential failure source and site of ethical dilemmas, evolving from device-driven adventures to system-generated dilemmas.

In narratives after the engineering turn, the "super-apparatus" is a balanced entity composed of interdependent subsystems. Its risks are endogenous and systemic. In *2001: A Space Odyssey*, the AI HAL 9000, designed to assist astronauts, chooses to eliminate them when threatened with shutdown. HAL's rebellion can be explained by two factors: first, a state of self-division caused by contradictory instructions (the paradox of obeying the crew versus concealing the mission, i.e., lying); second, a potential false report caused by a design error. Regardless of the explanation, the crux is the same: "humans caused the machine's rebellion." Kubrick expressed this panic about humanity's misuse of technology as early as 1968.

From Background to Narrative Core: The Engineering of World-Building

Industrialized philosophy of technology holds that technology, as a mode of revealing, participates in the establishment of reality as a constructive force, and industrial power is the concentrated manifestation of the "technological world". In the evolution of science fiction cinema, this shift from an instrumental view to a constructive view is particularly evident. Early world-building, influenced by adventure and utopian literature, focused on presenting visual spectacles with high recognizability. Whether it was the vertical city in Fritz Lang's *Metropolis* (1927) or the eclectic kingdoms of *Flash Gordon*, these worlds primarily served visual style, lacking coherent considerations of systemic issues like resources or social structures. The world was simplified into an object to be gazed upon.

The turning point occurred with *2001: A Space Odyssey*, setting a benchmark where films began to construct the physical layers of fictional worlds with the rigor of engineering blueprints. Details such as rotational artificial gravity and orbital mechanics weave a universe based on known physics. The world's rules become clear and consequential; characters must act in accordance with them. This pursuit of physical realism laid the foundation for the engineering of world-building—the world must first be a "feasible" physical system. This implies creators must conceive the infrastructure of a fictional world like engineers designing a city.

A paradigm of this is *Interstellar* (2014). The world is the consequence of a collapsing ecological-agricultural engineering system. The blight-induced collapse drives human civilization toward pragmatism. The film devotes substantial footage to engineering details of the *Endurance* space station and treats astrophysical concepts like black hole gravity slingshots as key engineering parameters. Here, the world and the device fuse, constituting a grand narrative problem to be solved with engineering thinking.

Once the world itself is engineered, the sources of narrative conflict change. Early conflicts often stemmed from external invasions or device abuses, resolved by individual heroes or shutting down a master switch. In *The Wandering Earth*, while the crisis (solar helium flash) is celestial, the narrative tension is internalized into the operation and failure of the "Wandering Earth Project" itself. The core conflict lies in the secondary system risks of this mega-project: engine failures, network shutdowns, and the organizational challenge of maintaining faith over 2,500 years (including the route dispute between the "Digital Life Project" and the "Moving Mountain Project"). The resolution depends not on individual heroism but on the collective work and sacrifice of global scientists, engineers, and ordinary people adhering to system laws.

This engineered world-building also influences character design. Protagonists have shifted from explorers and warriors (e.g., *Forbidden Planet*) to engineers, scientists, and system operators (e.g., Mark Watney in *The Martian*, Ryan Stone in *Gravity*). Their core abilities are professional competence and systems thinking. Their success relies on technical troubleshooting and adherence to procedures. Furthermore, technical vocabulary and scientific concepts in dialogue have become essential elements for advancing the plot and building audience trust, requiring cognitive participation from the audience.

Drivers of the Engineering Turn in Modern Science Fiction Cinema

The "engineering turn" manifests in two aspects: engineering activities becoming important objects of depiction, and engineering thinking permeating narrative construction.

First, this shift is rooted in the transformation of the sociotechnical environment. Post-WWII projects like the Apollo program transformed space travel from literary fantasy into a national engineering feat governed by strict laws. The subsequent computer and biotech revolutions reinforced technology as a complex, fragile system. Cinema reflects this; audiences living with global networks would find the "cannonball ships" of the early 1900s lacking credibility. Feasibility has become the necessary path to narrative self-consistency.

Second, the development of the film industry provides the material basis. CGI allows for the realistic visualization of complex mechanical structures, turning hidden engineering logic into intuitive narrative language. Moreover, film production itself is a complex engineering project relying on interdisciplinary collaboration. From hiring NASA experts for *2001* to Kip Thorne's involvement in *Interstellar*, scientific consultants now deeply participate in world-building to ensure internal consistency.

Finally, the turn responds to the evolving cognitive structure of the audience. The expansion of higher education and popular science media has raised public scientific literacy. Modern audiences unconsciously use physical laws to scrutinize films. A world that ignores energy conservation is easily questioned in the social media era. Thus, a rigorous, detailed engineering setting becomes an important means to construct narrative legitimacy and win audience trust.

Conclusion

With the evolution of the times, science fiction cinema has shifted from romanticist fantasy toward a systematic imagination of the relationship between technology and society. This "engineering turn" marks a fundamental narrative philosophical shift: from a mystified, individualized instrumental view of technology to a systematized, demystified constructive view. Technological devices and the world itself become dynamic systems embedded with complexity, fragility, and ethical dilemmas. Narrative conflicts shift from confronting external threats to managing internal system risks and examining humanity's position in a technological civilization.

However, vigilance is needed regarding new challenges. Does excessive pursuit of engineering credibility compress the poetic metaphors of science fiction? When system logic becomes indispensable, does it neglect humanistic depth?

In summary, the future of science fiction cinema may present a dialectical trend of "transcending engineering." While engineering thinking serves as the cornerstone for credible worlds, outstanding works must achieve a higher fusion of rigor and poetry. Future films should not only show *how* to build an engineering miracle but also question *why* it is built, finding a new balance between the blueprints of reason and the starry sky of sensibility.

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