Simulations of Climate Change: CGI and Hyperreal Representation in The Day After Tomorrow (2004) and Geostorm (2017)

Simulaciones del Cambio Climático: CGI y Representación Hiperreal en *The Day After Tomorrow* (2004) y *Geostorm* (2017)

Simulações de Mudanças Climáticas: CGI e Representação Hiperreal em The Day After Tomorrow (2004) e Geostorm (2017)

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Abstract: Baudrillard's concept of the hyperreal can be used to describe a context in which representation has achieved such a level of fidelity, resolution, and ubiquity that it becomes difficult to differentiate the referent from its representation. This level of representation is characterized by simulacra, representations that go beyond mere likeness to achieve structures of feeling and experience. In this respect, Computer Graphic Imaging (CGI) techniques have been important in forging hyperreal representation, with Hollywood productions exploiting these technological advances to portray stories, characters, and scenarios that are either difficult to represent or simply have no objective referent from which to obtain a model. The science fiction disaster film genre has exploited simulation and has been increasingly crossing over to climate change themes. *The Day After Tomorrow* (2004) and *Geostorm* (2017), are two examples of films that rely heavily on CGI to portray climate-related events that have no precedent in objective reality. This paper examines the use of CGI to portray climate change messages and their potential impact according to a theory of the hyperreal. I build on Baudrillard's assertion that simulation produces a referent-less notion of reality and uses concepts from Object Oriented Ontology (OOO), particularly Morton's (2011) idea of climate change as a *hyperobject*.

Keywords:

Climate change, hyperreal, simulations, representation, CGI, hyperobjects, Object Oriented Ontology (OOO), Geostorm, The Day after Tomorrow

Resumen: El concepto de lo hiperreal de Baudrillard puede ser utilizado para describir un contexto en el cual la representación ha alcanzado tal nivel de fidelidad, resolución y ubicuidad que se vuelve difícil diferenciar el referente de su representación. Este nivel de representación se caracteriza por simulacros que van más allá de la mera semejanza para lograr estructuras de sentimiento y experiencia. En este sentido, las técnicas de imágenes generadas por computadora (CGI) han sido importantes en la creación de representaciones hiperreales, con producciones de Hollywood explotando estos avances tecnológicos para retratar historias, personajes y escenarios que son difíciles de representar o simplemente no tienen un referente objetivo del cual obtener un modelo. El género de películas de desastres de ciencia ficción ha explotado la simulación y ha ido cruzando cada vez más hacia temas de cambio climático. *The Day After Tomorrow* (2004) y *Geostorm* (2017) son dos ejemplos de películas que dependen en gran medida de CGI para retratar eventos climáticos que no tienen precedentes en la realidad objetiva. Este artículo examina el uso de CGI para retratar mensajes sobre el cambio climático y su impacto potencial según una teoría de lo hiperreal. Me baso en la afirmación de Baudrillard de que la simulación produce una noción de realidad sin referente y uso conceptos de la Ontología Orientada a Objetos (OOO), particularmente la idea de Morton (2011) del cambio climático como un hiperobjeto.

Palabras-clave:
Cambio climático, hiperreal, simulaciones, representación, CGI, hiperobjetos, Ontología Orientada a Objetos (OOO), Geostorm, The Day After Tomorrow

Resumo: O conceito de hiperrealidade de Baudrillard pode ser utilizado para descrever um contexto no qual a representação alcançou um nível de fidelidade, resolução e ubiquidade tão elevado que se torna difícil diferenciar o referente de sua representação. As técnicas de Imagem Gerada por Computador (CGI) têm sido cruciais na criação de representações hiperreais, com produções de Hollywood explorando esses avanços tecnológicos para retratar histórias, personagens e cenários que são difíceis de representar ou simplesmente não possuem um referente objetivo. O gênero de filmes de desastres de ficção científica tem explorado cada vez mais a simulação e abordado temas de mudança climática. O Dia Depois de Amanhã (2004) e Geostorm (2017) são exemplos de filmes que dependem fortemente de CGI para retratar eventos climáticos que não possuem precedentes na realidade objetiva. Este artigo examina o uso de CGI para retratar mensagens sobre mudança climática e seu impacto potencial de acordo com uma teoria do hiperreal. Baseio-me na afirmação de Baudrillard de

que a simulação produz uma noção de realidade sem referente e uso conceitos da Ontologia Orientada a Objetos (OOO), particularmente a ideia de Morton (2011) da mudança climática como um hiperobjeto.

Palavras-chaves:

Mudança climática, hiperreal, simulações, representação, CGI, hiperobjetos, Ontologia Orientada a Objetos (OOO), O Dia Depois de Amanhã, Geostorm, The Day After Tomorrow

1. Introduction

We have arrived at a historical point in which the image has become an *a priori* mode of communication. In this context, images have become not only ubiquitous, but also increasingly effective in their representation of known and unknown referents. Baudrillard (2006) theorized this phenomenon as the hyperreal, a context in which the prevalence and uncanniness of simulations have rendered unnecessary the idea of the referent as an anchor for reality.

Advances in the field of CGI have been important fronts through which a culture of the hyperreal is applied, constructed, and fomented. Every year, Hollywood productions deploy and exploit these technological advances to portray stories, characters, and scenarios that are either difficult to represent or simply have no objective referent from which to obtain a model. The science fiction disaster film genre has exploited the power of simulation and has been increasingly crossing over to climate change themes.

The Day After Tomorrow (Emmerich, 2004, from now on *TDAT*) and *Geostorm* (Devlin, 2017), are two examples of films that rely heavily on CGI to portray climate-related events that have no precedent in objective reality. These films integrate anthropogenic climate change as a story device through which catastrophic climate events are depicted not only as visually realistic but also within structures of feeling and experience, which bring these representations to the real of simulacra, as theorized by Baudrillard (2006).

The aim of this paper is thus to examine the use of hyperreal CGI in these films that portray anthropogenic climate disaster events to discuss the implications of hyperreal digital sequences that portray climate change. I ask: To what extent do the scenarios represented in these films reflect plausible events of climate disaster? What are the implications of hyperreal CGI to the communication of the climate change emergency? To what extent could the possibility of a climate-change disaster genre obscure the construction of climate change as an objective phenomenon?

To do this, I rely on Baudrillard's (2006) implication that simulation produces a referent-less notion of reality and employ key assumptions from Object Oriented Ontology (OOO), particularly Morton's (2011) idea of climate change as a *hyperobject*.

2. Simulacra and Hyperreal Representation

The philosophic concept of hyperreality was developed by Jean Baudrrillard in the 1980s and, since then, has been applied to different contexts. What mostly concerns the present research are applications of the hyperreal to describe media representation, especially after the digital turn. In this respect, there has been considerable research concerning Baudrillard's (2006) understanding of simulation, as a precursor condition to the hyperreal, and its instrumentality for describing a hypermediated context.

From this perspective, hyperreality, as a historically defined moment, is the result of the continual advance of mechanical and technical representation. The image, since its advent as technology of representation, has progressively evolved in its capability to accurately represent the referential world in terms of likeness, resolution, and delivery. In addition, mediation technologies, which are centered around images, have made this mode of representation ubiquitous. This, according to Mirzoeff (1999), is at the center of a visual culture in which "which information, meaning, or pleasure is sought by the consumer in an interface with visual technology" (p. 3). Furthermore, because of our historical capability of visualization, we have culturally and historically transitioned to an insistence in visualizing what is not visualizable, especially because of our capacity to represent anything (p. 6).

For Baudrillard (2006), this technocultural progression has necessarily tampered with what he called "the reality principle," which we could describe as a historically situated conception of reality. The reality principle, in this respect, is closely connected to the image's capacity to accurately represent its referent. For this, it is useful to invoke Saussure's (1945) concept of the sign's motivation, which speaks to a sign's level of arbitrariness in its connection to its referent. For instance, the linguistic sign "C-A-T" has a "weaker" or "lesser" level of motivation than an iconic sign of the same referent.

According to this axiom, visual representations also vary in terms of their level of motivation with respect to what they represent. Thus, a portrait painting has a weaker level of motivation than a photograph of the same subject, independent of the artist's skill or proficiency. For instance, if we look at George Peter Alexander Healy's portrait painting of Abraham Lincoln, at the Smithsonian's National Portrait Gallery, we can see a beautiful painting that accurately depicts the former US president. The portrait shows excellent

technique, portraying fine details and realistic illumination. Yet, if we compare it to Alexander Gardner's 1865 photograph of Lincoln, we can appreciate a level of likeness that is simply unavailable to the oil painting medium. Even for such an early photograph, mechanical representation captures its referent in "lifelike" detail, in a way that not only "looks" like its referent, it *embodies it*.

Thus, the image's level of motivation with respect to previous forms of visual representation directly influences the reality principle, in that it blurs the frontier between sign and referent. In this respect, an oil painting will not disrupt the reality principle because there is a fundamental representational limit to the medium: A painting always signals its quality as representation. An image, conversely, can easily be taken not as representation, but as the very thing it represents. It effectively erases its representational qualities; it effaces its identity as a sign. As such, it disrupts the reality principle, which is to say that it destabilizes our historical understanding of stands to be real or true.

Once the image has achieved an uncanny level of representational value, it moves from the level of representation to that of simulation. For Baudrillard (2006), simulation is a state in which the signs of reality and those of the simulation have effectively merged in such a way that their distinctive identities are no longer recognizable. The simulation achieves this by going beyond the mere representational qualities of its referent, such as likeness, and exploiting the dimension of experience. Thus, after achieving full command of its referents' attributes, it deploys them within a structure of feeling and experience.

The simulation disrupts the reality principle precisely because it conceals a referential origin. For Baudrillard (2006), this results in representations without referents. Whereas visual representation before the image depended on referents for anchoring meaning, images today no longer require a referent in order to signify. Images, in this respect, no longer succeed the referent. On the contrary: An image can now be its own referent. Once the simulation has reached such a level in society, we have effectively entered the hyperreal.

To put this in our current digital context, images today have become the *a priori* means of signification: They are ubiquitous, generated at will, with great resolution and display capacity, in the palm of our hands. Images are software rendered and enhanced, seamlessly manipulated, and AI generated. They have become the main access to the world, as we experience events, relationships, and information "image first."

3. Hyperreal Depictions of Disaster

The disaster film genre has by now been positioned as an established category in filmmaking and has become an accepted trope for Hollywood blockbuster material. While there have been natural disaster movies dating back to the seventies (such as *Tidal Wave* or *Earthquake*), the genre has been particularly boosted and supported by the progressive advances of Computer-Generated Imagery (CGI). The reason for this lies in the technologies' capacity to represent with visual accuracy and dramatic effect the magnitude, scale, and power of catastrophic events.

As a genre, it has been progressively moving away from the mode of representation and increasingly pioneering the mode of simulation. Today, it is no longer enough to portray a disastrous event with representational accuracy and fidelity, such as in the beginning of special effects. Likeness of representation is conjured within a complex of representation that includes not only visual attributes, but also physical behaviors, material textures, environmental determinants, and sonic qualities. Algorithms and narrow artificial intelligence calculate shapes, physical behaviors, and illumination in order to render hyperreal worlds that do not necessarily refer to a referential world.

In this sense, the disaster genre has been able to visualize events that were formerly un-visualizable. Helmreich (2018), in his examination of massive waves in movies, described the ways in which wave representation has changed over time. He cites the visual effects supervisor for the film *Interstellar* (from 2014), Paul Franklin, and their approach to simulating a 4,000-foot wave on a fictional planet, who described a process of "rigorous simulation of what water should actually do using physics simulations to work out how do the waves splash and sweep the aircraft away" (p. 500). What interests me the most about this description is the fact that neither the wave nor the planet are bound by a real referent. Yet, as viewers we recognize the "reality" of the depiction in terms of texture, behavior, color, illumination, sound, on so on. In fact, we not only "see" the way, we are able to experience its representation as it interacts seamlessly with "real" humans (the actors and actresses). Furthermore, in his examination of the 2015 film *San Andreas*, he describes the disintermediation of what was once a mandatory relationship between the camera and the referent being filmed, which departs from the "indexical or analogical promise of old-fashioned film", stating that "digital cinema no longer offers a *record* of time, but rather generates a *simulation* of time" (p. 501, emphasis in original).

He is referring to the technique of using a virtual camera in digital film, one which provides the audience with hyperreal perspectives that would be impossible otherwise, a

point of view of fighting for your life in a tsunami, watching a giant meteor enter the atmosphere, or be engaged in combat with an intergalactic titan, for example. What all these points of view have in common is the irrelevancy of a referent to conceive the representation.

Thus, digital representation employs a series of techniques that are deployed and enhanced by powerful computing power, algorithms, and artificial intelligence. Motion tracking, 3D graphics, virtual lighting, compositing, and FX simulation are only a few of the digital techniques that make possible hyperreal representation. Through these techniques, it is possible to transcend the mere referential capabilities of representation and attain the experiential capabilities of the simulation.

4. Hyperreal Representation in *The Day After Tomorrow* (*TDAT*) and *Geostorm*

In the context of CGI-driven fiction, at least two movies within the disaster film genre have made an explicit incursion into matters of anthropogenic climate change. *TDAT* (Emmerich, 2004) and *Geostorm* (Devlin, 2017) exploit the affordances of digitally rendered representation to propel a story in which the catastrophic consequences of global warming and climate change must be endured and survived.

The main premise of *TDAT* (Emmerich, 2004) is that, because of global warming, there has been a fundamental collapse of the Gulf Stream, propelled by the melting of the polar ice caps. This unchains a series of climate events, from massive tornadoes to tsunamis, which eventually results in a new ice age. The plot itself is modelled after the 1999 book *The Coming Global Superstorm*, which contends that anthropogenic global warming will result in drastic, sudden, and catastrophic climate change.

Since its release, scientists expressed fundamental flaws in the depiction of the catastrophic climate events that make up the story. For instance, they signaled the impossibly quick onset of climate effects and the defiance of the laws of thermodynamics in some scenes. Reactions to the rhetorical impact of the film among the scientific community were mixed, with some scientists acknowledging the distance from scientific facts of its disaster scenes but accepting the potential public impact on discussions of climate change to those who simply viewed the film as a disservice to public awareness about the issue.

Despite this, the movie can be considered a milestone of digital effects, with some pioneering techniques at the time. According to the film notes (cited by Wikipedia but no longer available), the film used 416 visual effects shots, with nine effects houses, and over 1,000 artists. Digital Domain (n.d.), an effects studio involved in the film, described the tidal wave hitting New York City in the film as "intelligent, interactive CG water sweeping

through photorealistic recreations of lower Manhattan". On accomplishing this, Karen Goulekas, the project's VFX supervisor, said:

> We knew we had to do 13 blocks of New York, around 5th Avenue, 41st to 42nd street, all around the library, and the Empire State Building. It took three months to get 13 blocks. And at the same time we had three teams of photographers take over 50,000 building texture photos. (Restuccio, 2004, par. 6)

In addition, the film also features a three-minute fly-over of the Larsen B Antarctica ice shelf (4,000 frames), one of the longest continuous, all-digital shots in a live-action film in film history (Filmsite, n.d.). This technical context exemplifies the foundation behind the films most notorious hyperreal scenes.

One scene depicts the destruction of Los Angeles by several, large-magnitude tornados. The sequence portrays with great intensity and hyper-realistic effects different points of view of the destruction. Virtual shots allow us to view the approaching tornados, in all their fury and uncanniness, from above and below, and from the point of view of some of their victims. Skyscraper windows blow up, in exactly the ways we would expect them to, and buses are lifted from the ground and flown in a spiral, behaving just like we would expect a large object to behave in a tornado. If fact, there are several shots in which we see the tornados being broadcast live on TV, perhaps as an indication of the hyperrealism at play.

Another scene shows how a tidal wave, provoked by massive storm surge, travels with force toward New York City. As the wave approaches, it almost covers the entire Statue of Liberty. As it begins crashing into the city, we see, from a virtual shot from above, the water, with life-like whitewash foaming against the structures, advancing. The illumination is just right, the buildings look photo realistic.

The film *Geostorm* (Devlin, 2017) employs similar catastrophic scenes to depict the effects of climate change. For example, in one such scene, fire begins to erupt from the streets of Hong Kong. A virtual camera starts to follow a car that is desperately trying to avoid and escape the towering flames, which keep erupting as the car speedily traverses the streets. The city at night blends seamlessly with fire.

In another scene, on a beach in Brazil, a massive cold front quickly hits beach goers who are sunbathing in the sand, freezing them instantly. Right before, a virtual shot allows us to see how the cold air instantly freezes a wave just before it hits the shore full of people. People try to escape the event, and some freeze instantly.

One of visual feats of the movie was to create a CGI simulation of the International Space Station (ISS). For this, they built dozens of digital modules that would then have to be

put together for a final rendition. In one scene, the ISS is destroyed. Explaining how they approached this from a visual engineering standpoint, CG supervisor Alexis Wajsbrot said:

> It was much harder for fire because we don't really know how an explosion looks like in zero-G […] We had to do a mix of how real fire looks on Earth and bring a touch of magic because there's no atmosphere and oxygen so it needs to ignite but turnoff quickly. We had to build a lot of different libraries of fire that we could populate on the ISS on some of the wide shots. (Hogg, 2017, par. 12)

This exemplifies the lengths to which digital representation goes in order to go beyond mere representation and approach an experience of the event (a simulation).

5. Hyperreality and the Problem of Representing Climate Catastrophe

TDAT (Emmerich, 2004) received much attention upon its release, provoking varied debates about the film's ability to accurately portray climate change events and its potential positive or negative contribution the public's understanding or assimilation of global warming as a reality. For example, Stefan Rahmstorf (n.d.), a scientist at the Potsdam Institute for Climate Impact Research, discredited some of the scenes as not being scientifically grounded (for instance, the abruptness of the onset of catastrophic effects, the impossibility of storm-surge induced tsunami). And yet, in the end, he stated that "it would be a mistake and not to do the film justice if scientists simply dismiss it as nonsense" (par. 9).

Other research suggests at least a moderate "positive" impact of the film in audiences, raising awareness on climate change and even prompting personal and political action (see Leiserowitz in Von Mossner, 2012). Part of the explanation, Mossner suggests, has to do with the film "comes across as pure entertainment, with no apparent pedagogical agenda to push, but with a strong visceral and emotional impact on its audience" (p. 103). However, the device of spectacular and emotive representation may also come as political shortcoming. As Von Burg (2012) asserts, due to the exaggerations of its depictions and their distance from the real, "usage of TDAT (Emmerich, 2004) as a rhetorical device to promote public awareness on climate change invites skeptics to suggest that scientific endorsements of the film are indicative of shortcomings in global warming science" (p. 11).

Like any form of mediated representation, effects are not linear nor guaranteed. In fact, one can expect that climate change "texts," such as movies, can be interpreted in myriad ways and to different ideological outcomes. Hall (2006) famously proposed a communication model in which the way audiences receive messages is traversed by multiple determinations,

including cultural historical, and technical. Both production and reception are constrained by such determinants, and this can challenge or destabilize the reception of an intended message.

Up to now, what has been studied about these films is their rhetorical value. That is, analyses have focused on the content of its representations, dismissed mostly as ridiculous depictions that have no connection to reality. While this assertion may be true from a rational perspective, what I would like to discuss here are the possible deep-meaning systems of representation that may lie in the ways these events are portrayed. In this sense, the present work adds a formal dimension to previous analyses as a way to further examine the possible ideological outcomes of a genre such as the climate-change disaster film.

For this analysis, and evidently for previous ones, a fundamental ontological assumption must be established, which is that anthropogenic climate change is *real*. For this, I will recur to Morton's concept of the hyperobject to distinguish global warming as both an objective reality and an elusive, unknowable phenomenon, perhaps not even visible to certain sectors of society.

Morton (2011) coined the term *hyperobject* to explain the existence of certain material phenomena that transcend both our comprehension but also our symbolic ability to grapple with them. That is, hyperobjects exist independently of our cognition and ideological recognition of them. They have consequences, whether we hold them to be true.

Styrofoam, fossil oil, or radioactive waste can be seen as hyperobjects. Climate change is also a hyperobject. Morton (2011) says:

> These are objects that are massively distributed in time and space. Hyperobjects become visible to humans in an age of ecological crisis. Indeed, it's really the other way around: hyperobjects have alerted us to the ecological crisis that defines our age: for instance, global warming and nuclear radiation from plutonium. (p. 207)

Under this view, we know of climate change, but we cannot fully comprehend its magnitude. As Meis (2021) observed in a profile on Morton, "there's just an infinite expanse of objects, which have as much power to determine us as we have to determine them."

This approach to materiality is supported by an ontology of objects, which does not reduce reality only to our symbolic construction of it. I believe this to be a crucial recognition for any politics of climate change, but one that places great importance on the ideological machinery instrumental to the construction of meaning, such as the media. Put differently, our recognition of objects stresses the dangers of the obfuscation inherent to the ideological terrain. As Bryant (2011) states, "in an age where we are faced with the looming threat of

monumental climate change, it is irresponsible to draw our distinctions in such a way as to exclude nonhuman actors" (p. 24).

We can therefore adduce to certain signs that render the hyperobject of climate change intelligible. The global consensus on climate change, for instance, adds to the situated credibility of the phenomenon. Myers et al. (2021) found that agreement on anthropogenic global warming ranges from 91% to 100% and that "expertise predicts consensus, where the higher level of expertise results in a higher level of agreement on [anthropogenic climate change]" (p. 8). Similarly, Lynas et al. (2021) found that "there is no significant scientific debate among experts about whether or not climate change is human-caused" (p. 6).

However, the assumption that global warming is true must reckon with the fact that our approach to that event is also ideologic. Althusser (2006) defined ideology as an imaginary relation to real conditions of existence (p. 82). This means that there is an objective reality, but how we act in the context of that reality is determined by how we think about said reality. That is to say, whether there is an objective reality of climate change, public recognition, perception, and behavior is determined by an ideological position to the issue. Climate deniers, regardless of their motivation, exemplify this.

Thus, media representation of climate change becomes a true battleground from which public perception of the issue can be constructed or contested. In this sense, the rhetorical and formal qualities of climate change messages become center-stage in any effort to galvanize the issue as an objective reality that threatens existence as we know it. Representations about climate change are as important as the science and politics that posit its materiality.

To a technoculture of the hyperreal, however, the uncanny nature of the simulation is what matters the most, not the anchorage of the depiction with a potential referent. In this sense, the experience of the catastrophic climate event is in and on itself the endpoint. The combination of digital imagery techniques, along with digitally rendered sound, high-fidelity speakers, and a virtual camera that allows omniscient perspective, we are able to immerse ourselves in events that have no real referent in material experience.

Both films, thus, portray powerful signs that are not referentially anchored. They offer a simulation of climate disaster that brings global warming to the realm of the hyperreal.

To be sure, global warming can only be discerned in relation to the climate disasters it unchains. That is, global warming has an absent presence in the films since, as a hyperobject, it cannot be enacted. In *TDAT* (Emmerich, 2004), there is reference rhetorical reference to global warming as the protagonist Jack Hall, a paleoclimatologist, warns nation officials at a UN conference about his research and the possibility of climate change. In *Geostorm* (Devlin,

2017), the film opens with a montage that speeds through a past in which catastrophic climate change has already taken place. However, we only see myriad catastrophic climate events in different places of the world, while only a narrator, a little girl, clues us in about their cause ("Everyone was warned, but no one listened"). These catastrophes, therefore, are the only phenomena simulated.

There is a natural progression in the arena of simulation. Baudrillard (2006) stated that, in a context in which signs no longer point to referents, representations can only refer to other representations. That is, the referent of a representation becomes representation itself. What would happen if the climate-change disaster film genre were to fully crystallize? Films after *TDAT* (Emmerich, 2004) and *Geostorm* (Devlin, 2017) would seek reference in those initial films, in long concatenation of referentiality, in an attempt to surpass them in hyperreal quality.

6. Conclusion: Toward an Understanding of Hyperreal Representation of Climate Change

Because global warming is a hyperobject, we cannot necessarily fully appreciate its "realness." In an age of simulacra, we rely on hyperreal representations to assert or discover that which is not intelligible, that which is "unvisualizable." By way of providing both a structure of likeness and experience, the simulation is able to do away with the necessity of the referent.

In the case of simulations of climate change, how important is the referent? The danger of simulations is that they can only refer to themselves, in a perpetual close circuit of meaning. They render the need for the referential world irrelevant. If hyperreal representations of climate change were to become the norm, with a new blockbuster franchise every year, what would happen to public recognition of climate change?

Presumably, the material "realness" of climate change would increasingly drift away from its referential anchorage. It would become "real" as long as it finds validation in its own simulation.

This posits further need for interdisciplinary research and consideration, from science communication to reception studies to visual effects and production: How could can scientifically sound messages be communicated in an ecosystem traversed by hyperreal representation? How do audiences rationalize what they experience in terms of hyperreal representations and to what effects? How can audiovisual producers acquire a complex

understanding of hyperreal representation and apply it ethically to the future of digital rendering?

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