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Digital twin-based universe (complexiverse): Where real world and virtual/digital world are unified

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1. Introduction to virtual/digital world

The concept of a virtual world is something we conceived and subsequently created. Cyberspace emerged in 1982, by a science fiction writer William Gibson. It refers to a computer-generated virtual world entirely separate from reality. In this new world, users could solely focus on computer-mediated communication. Moreover, all online activities were conducted in an environment isolated from the real world. Thus, in the early-stage, there was a complete separation between the virtual/digital and real worlds

Following the Internet boom in 1991 (World Wide Web) and the development of Yahoo! Messenger (1998-2018), we became familiar with and spent more time in an instance of this virtual world case #1 . However, the connection between the two worlds was limited only to communication (images, text, voice, video, etc.), and its level of realism was much lower compared to real-world experiences. Later, with the advent of Facebook (from 2004), we experienced another virtual world case #2, with higher level of realism and vividness. But Facebook was still more virtual than real life. In 2022, Facebook rebranded as Meta, aiming to create a virtual world that coexists with the real one. This allows us to see virtual objects through augmented reality (AR) and virtual reality (VR) devices. However, currently, it's just a slight interleaving of the small real world into the virtual one, making the virtual seem more real (increasing level of realism, even allowing for an additional haptic feedback). Nevertheless, images and people on Facebook are still not entirely the same as they are in the real world. However, the concept of "digital universe" / "virtual universe" has existed for a long time. The origin of the Metaverse can be traced back to 1992 science fiction novel Snow Crash (by Neal Stephenson). He used the term "Metaverse" to describe a virtual world where people interact with each other through digital avatars. In 2022, Lockheed Martin collaborated with NVIDIA to build a prototype of an "AI-driven Earth and Space Observing Digital Twin", with potential to advance predictive forecasting. In 2024, NVIDIA announced its Earth-2 climate digital twin cloud platform (for simulating/visualizing weather and climate of the entire plane). In 2023, Suffescom Solutions Inc. launched a project on "Earth2 clone": a 1:1 virtual representation of the real world (Earth2 Metaverse).

Therefore, in the growth stage, there was the evolution of the virtual world through various form, from simple to more complex forms.

Overall, from the early-stage to growth stage, we aspire to bring the virtual world closer to the real world with increasing levels of realism, thanks to advancements in science and technology.

2. Digital twin computing in the digital twin-based universe

In 2000, Gartner coined the term "Supranet" to describe the fusion of the physical and digital worlds, a concept depicted in a film they produced. Unifying the real and virtual worlds seems to remain confined to the realm of ideas or science fiction, where there are no boundaries between the two. This idea might have seemed impossible in the past, could very well become a reality in the near future with rapid advancements in science and technology.

In a traditional Digital Twin framework, the various objects are built digitally and evolve lonely. However, in the new Digital Twin computing, it develops from the lone Digital Twins to synchronize/integrate the real and virtual/digital worlds.

By using digital twin computing, researchers can now realize the idea of dublicating objects (human or things), by synchronize the real and virtual/digital worlds in real time to reflect the same data/features. Thus, in the future we can imagine a digital twin-based universe where real world and virtual/digital world would be unified.

On the other hand, the industry 5.0 currently focuses on the interaction between humans and machines/robots. Robots become more important, and can be connected to the human mind via the brain-machine interface. Interaction between humans and robots can be divided into two groups: humanoid robot and robotic human/digital human. In the case of humanoid robots, although many of them are still in the prototype phase, a few have entered the real world as bartenders, concierges, deep-sea divers and as companions for older adults. In the case of digital humans, they might be photorealistic digitized virtual versions of humans. While they don't necessarily have to be created in the likeness of a specific individual human, they could look and act like humans [1].

The digital twin computing based framewords include, but not be limited to the following topics:

- Cancer digital twins/Cancer Patient Digital Twin [2]

- Patient Digital Twin/digital twin of patients

- Human digital twin/digital twin of humans [3]

- Bio-wave based digital twin

- Digital twins for pandemic monitoring and prevention

- Digital twin in smart healthcare [4]

- Digital twin in smart hospitals [5]

- Digital twin for smart cities/ Smart city digital twins [7, 8]

- Digital twin for smart manufacturing [9]

- Digital twin for smart agriculture [10]

- Digital twins in livestock farming

- Digital twin in logistics and supply chain management [7]

- Digital twin systems for disaster management [7]

- Digital twin technologies and smart grid [7]

- Digital Twins for heritage preservation and cultural tourism [7]

- Digital twins to the product lifecycle management [7]

- Digital twin for construction industry [7]

- Digital twins in smart transportation [11]

- Digital twins in smart infrastructure/ Roads infrastructure digital twin

- Digital twins in the automotive industry [11, 12]

- Digital twins for the circular economy [7]

- Digital twins in smart education

- Digital twins for environmental sustainability and climate change

- Climate digital twin/weather digital twin

- Artificial intelligence in the digital twins

- IoT-enabled digital twins

- Blockchain-based digital twins (integration of blockchain and digital twins)

3. Bio-wave based digital twin: Towards a human digital twin in the complexiverse

Bio-wave refers to the natural electromagnetic wave (with natural frequency) produced by living cells, tissues or organisms. Natural frequency refers to the inherent vibration frequency at which an object (human or thing) naturally vibrates when disturbed. By testing the response of the human body on a vibrating platform, many researchers found the human whole-body natural frequency to be around 5 Hz or 10 Hz. Biomechanical human body models show the natural frequencies of individual organs ranging from 4-30 Hz. Thus, human bio-wave is the Radio waves ELF (extremely low frequencies: 3-30 Hz). The frequencies most (clinically relevant) brain waves range from are 3-13 Hz. As reported, a healthy human EEG shows the main range of frequencies between 1 and 30 Hz.

For human bio-wave, in case of brain waves, the Electroencephalogram (EEG) contains the oscillating electrical voltages in the brain measurement. Whereas, the Magnetoencephalography (MEG) measures the magnetic fields that the brain's electrical currents produce.

Analysis of bio-waves can define the human health status. Under interaction between the electro-physiology/magneto-physiology (within the human body) and external fields (other EM, or thermal/electric/magnetic/optic/geomagnetic… fields), the inherent bio-waves might be modified. Bioresonance therapy is based on the idea that unhealthy cells or organs emit altered bio-waves (electromagnetic waves) due to

DNA damage. Proponents of bioresonance believe that detection of these bio-waves can be used to diagnose disease, while changing these bio-waves back to their normal /natural frequency will treat disease. Bioresonance therapy is purported to diagnose and treat a number of health-related conditions.

In the future smart healthcare with realtime/long term bio-wave monitoring, big amounts of data are collected. Thus, an effective digital signal processing/analysis algorithm, integrated with artificial intelligence (AI) and machine learning (ML).

For human digital twin in the complexiverse, data from realtime bio-wave monitoring are very useful.

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