RESEARCH ARTICLE

Mathematical developments in the simulation hypothesis

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Abstract: Simulation Hypothesis is based on the idea that it might be the case that we all are present inside a computer. In this paper, we have performed some mathematical calculations based on the well-known equations of physics to further progress and understand the abilities and features of such a computer. One of our finding is the relationship of the essence of time between the computer and the simulation.

Keywords: quantum physics, simulation hypothesis, Planck's time

1 Introduction

Physics have been used to understand the underlying laws of nature. This exploration have lead to the discovery of many phenomenon such as electromagnetism etc. and have also helped in exploring new ways to understand the nature, such as quantum physics, cosmology, relativity and so on. One such area is the simulation hypothesis which is based on the idea that we are present inside a simulation, even the weird nature of quantum physics such as superposition starts making sense when we start analyzing nature using the simulation hypothesis.

In this paper, our work is focused on knowing more about the features of the computer which would have made such a simulation possible. One of our findings is quantifying the computer's time with relation to the understanding of time inside the simulation.

2 Mathematical work

In classical physics [1], Work Done is defined as:

$$\mathrm{WorkDone} = \mathrm{Force} \cdot \mathrm{Displacement} \tag{1}$$

From the energy-mass relationship [2] of Albert Einstein,

$$\mathrm{E} = \mathrm{MC}^2 \tag{2}$$

where,
E is energy, M is mass, and C is the speed of causation.

When comparing the Equation (1) and (2), from the computer's view point in the simulation hypothesis [3]:

$$\begin{gathered} \mathrm{Energy} = \mathrm{WorkDone} \\ MC^2 = M(v/t)d_s \end{gathered} \tag{3}$$

where,
v represents the velocity,
t represents the time, and
d_s represents the displacement.

Now, suppose the entire mass present in the simulation gets accelerated from rest, with the value equal to that of C, then the following equation holds true only for t_c = 1 second.

$$v = u + at_c \tag{4}$$

Here, t_c represents the total time taken by the computer to perform this operation inside the simulation.

Interestingly, the Equation (3) holds true for t =1 seconds when the velocity is equal to C. This suggests that the computer have provided this simulation only 1 seconds of it's time to exist and this 't' represents t_c.

Now, let us try to calculate the time inside the simulation t_{s_eq} after which the overall lag-time will became equivalent to the 1 seconds of computer time (t_c = 1). According to various research works, in our nature (*i.e.* simulation) there is a minimum observable time which is not equal to zero, some physicists suggest that it can be the Planck's time h_t.

Let us say that the minimum measurable time inside the computer simulation is t_{s_min}. It suggests that for the computer to perform any operation inside the simulation, there is a lag-time of t_{s_min} We can use this lag-time to compute when will this lag-time will get equivalent to 1 seconds of t_c.

For this lag-time to get equivalent to t_c = 1 seconds. It will require:

$$1t_c = t_{s\_min} \times t_{s\_eq} \tag{5}$$

$$1t_c = (t_{s\_min}) \times (1/t_{s\_min}) \tag{6}$$

From Equation (5) and (6), we get:

$$t_{s\_eq} = 1/t_{s\_ min} \tag{7}$$

In case, if the t_{s_min} is equal to h_t than,

$$t_{s\_eq} = 1/h_t \tag{8}$$

3 Conclusion

The proposed relationship between the time inside the simulation and the computer's time will provide better understanding for the further development of the simulation hypothesis.

References

[1] McCall MW. Classical Mechanics: From Newton to Einstein: A Modern Introduction. John Wiley & Sons; Oct 11, 2010.

[2] Wong CL and Yap KC. Conceptual Development of Einstein's Mass-Energy Relationship. New Horizons in Education, 2005, **51**: 56-66.

[3] Macleod MJ. Programming Planck units from a virtual electron: a simulation hypothesis. The European Physical Journal Plus, 2018, **133**(7): 1-3.

