NUMBERS, MATHEMATICS and PHYSICS

a note with a philosophical discussion of concepts

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I lost my Emeritus Status on June 30, 2016.
It was not because of no publications in one year
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note version

August 31, 2020

Abstract

Concepts like finite, infinite (∞) and zero (0) are discussed. Numbers are the birth of mathematics. Mathematics is a language that is used in connection with the creation of models of the physical observations of our environment, the universe. The concepts of absolute and time-varying coordinate systems are discussed. The dimension of the universe is discussed. Space and time are discussed. Einstein's coupling of space and time is questioned. Do we understand these concepts?

Please contact the author (erik.lindberg@ieee.org) with your comments concerning this fractal note. I believe that some valuable ideas are presented despite of the chaotic nature of the note.

1   Introduction

We are human beings living in a wonderful world. We are very curious so we observe our environment. We want to understand our observations. To discuss our observations with other human beings, we invent "Languages" like "Mathematics" and "Physics" as supplements to our "Mother languages". We use models and concepts in our descriptions of our observations.

We have severe problems with our assumptions, definitions, and understanding of the models and the concepts.

Each of us is the center of his personal unique universe according to his universe model. It may be a sphere in which the diameter is based on the speed of light ("Hubble Sphere"). In cosmology, a Hubble volume or Hubble sphere is a spherical region of the observable universe surrounding an observer beyond which objects recede from that observer at a rate greater than the speed of light due to the expansion of the Universe. The Hubble volume is approximately equal to (10 raised to 31) cubic light-years.

We observe that the universe is expanding. At the moment we observe red-shift but it might be that sometime in the future we may observe blue-shift. That is, we may assume that the universe is oscillating with an infinite number of Big Bangs [1]. The Big Bang may be a maximum or a zero crossing of an oscillator, so we can avoid the peculiar singularity with nothing becoming everything in no time.

We may assume that our universe is the center of an infinite universe, which is the same for all of us. The borders between our local universes are fractal. When you zoom in on a border between two entities, it will disappear. The entities overlap each other in a very complex pattern. Seen from the sky we have a static borderline between sea and land. When you zoom on a coast you observe a dynamic border. When you zoom on the surface of a crystal glass it becomes a mountain landscape. When you zoom on the edge of a sharp knife it becomes a saw.

In physics, the concept of chaos is defined as a deterministic dynamic system that apparently behaves in a stochastic way. You may observe "strange attractors", in fractal patterns. An oscillator may oscillate on many different frequencies at the same time.

Nothing is something with the size zero. There is no limit between nothing and the environment of nothing. Something without any limit may be described by the concept of infinity. Sometimes zero and infinite are numbers. Sometimes they are references, labels, points. Maybe the number zero is just very small but finite. Maybe the number infinite is just very large but finite. Sometimes zero and infinite are equivalent. In short: *We do not understand the concepts of zero (0) and infinite (∞).*

We have two kinds of zeros: Mathematical and Physical. A mathematical zero is a pattern. A physical zero must be a "zero particle" with zero mass and zero volume. In physics, we operate with many kinds of particles. The smallest elementary particles are the superstrings. The particles of the empty space, called the ether, are the zero particles. Energy needs a medium for transmission. We observe light in the universe. Some people claim that the ether does not exist. We are on the fractal border between science and religion. In the bible, the Big Bang is mentioned with the words: And God said, "Let there be light," and there was light (Genesis 1:3).

Question: Is God behind the concept of Physics?

A number is a mathematical object used to count, measure, and label [2]. In Wikipedia, you may find a lot of information concerning the number concept.

The English scientist Tim Berners-Lee invented the social media WWW (World Wide Web) in 1989. He wrote the first web browser in 1990 while employed at CERN near Geneva, Switzerland. The basic idea was that it should be free for

all. Unfortunately to-day the WWW is polluted by advertising and costly services because of greedy people. The concept of money is controlling the world. We speak about the GOD Mammon.

2   Number-spaces

We invent natural whole numbers (integers) so we can speak about the amount of the apples we get from the trees. One apple was sufficient for the physical concept of gravity defined by Newton. We also invent arithmetic for combining the numbers e.g. addition, subtraction, multiplication, and division, so we can properly share the apples. The number systems (2, 10, 20, 60, etc.) are based on the number of our fingers and toes.

If we take a bite of an apple we have two fractions the sum of which is one ($1/3 + 2/3 = 3/3 = 1$). The number one (1) is a special (reference point) like zero (0) and infinite (∞). In the number system based on ten (10) we introduce decimal fractions which may be described with an infinite number of decimals (0.333333... + 0.666666... = 0.999999... = 1.000000...).

The numbers (0.999999...) and (1.000000...) are not equal. Each of them has an infinite number of digits. They must be neighbours. Between the two numbers there must be an infinite number of a special kind of numbers larger than (0.999999...) and smaller than (1.000000...). On the number-line numbers are represented using points. The area of these points is zero.

In our computers, we operate with numbers which have a finite number of digits. The numerically smallest negative number represents minus zero (-0) and the smallest positive number represents plus zero (+0). The numerically largest negative number represents minus infinite ($-\infty$). The largest positive number represent plus infinite ($+\infty$).

We introduce the concept of irrational numbers like ($\pi = 3.1415928...$) and square-root of a number ($\sqrt{2} = 1.4142135...$). With reference to Wikipedia we introduce negative numbers, rational numbers, real numbers, and complex numbers. Complex numbers are number pairs.

We do not understand the concept of a number with an infinite number of digits.

2.1 Space dimension one 1

Euklid of Alexandria was a Greek mathematician who invented geometry with points, lines, and circles. We model the numbers as points on a straight line. Between two numbers on the line, there is an infinite number of real numbers. The area of a geometrical point is zero. We use the number zero as a reference point on the line. Negative numbers are between minus infinity and zero. Positive numbers are between zero and plus infinity.

If we assume that it makes no sense to put a sign on infinite then our straight line must be a circle with infinite diameter. We may speak of a *number-circle* instead of a number line. The dimension of this circle is one. We may speak about distance along the circle. The distance between two numbers on the number circle is the difference between the numbers. The reference points zero and infinite are opposite each other at the ends of a diameter. They play the same role as reference points and numbers with no sign. The number-circle is a fixed x-coordinate system of dimension 1. Interestingly, dimension one must be seen from dimension two if you want to understand the pattern.

We may introduce time (see later) and speak about moving along the number-circle. If we do that, we must introduce intervals without the numbers zero and infinite where concepts like length, distance, velocity, acceleration, and period may be defined. Dimension one must be seen from dimension two if you want to understand the pattern.

Normally we use the interval between zero and infinite in the direction from zero to infinite. The concept of velocity or speed along the circle may be defined as distance divided by time. The velocity may be constant or time-dependent. We assume that the circle is continuous. We have problems with the definition of continuous. A graph is a continuous curve but it may be fractional when you zoom in.

2.2 Space dimension two 2

In dimension two we have a plane. We can speak about an area in this plane but XY-coordinate systems become undefined because of infinity in all directions. Also, we can speak about the distance between two points in this plane. In the plane, we have infinite in all directions. If we turn around the number circle about the

diameter the plane becomes a sphere with an infinite diameter and zero and infinity opposite each other. Now the XY-coordinate systems become fixed of dimension 2. Dimension two must be seen from dimension three if you want to understand the pattern.

We may introduce the concepts of distance, velocity, and time on this infinite sphere as we did for the number circle.

2.3   Space dimension three 3

Now in dimension three, we have a ball or a sphere, We can speak about volume but XYZ-coordinate systems become undefined because of infinity in all directions. Also, we can speak about the distance between two points in this sphere.

We now do the same in dimension three as we did in dimension one and dimension two. We press together the sphere between zero and infinite so it becomes a torus or a doughnut with no hole. This seems to be a proper model for the static universe concept, the universe doughnut model. The torus model is a cosmological model proposed in 1984 by Alexei Starobinsky and Yakov Borisovich Zel'dovich at the Landau Institute in Moscow [3].

Our XYZ-coordinate systems become fixed of dimension 3. Dimension three must be seen from dimension four if you want to understand the pattern. Unfortunately, as a human being i.e. a three-dimensional subspace of the universe, you do not understand dimension four even you are dynamic.

We may introduce time so the model becomes dynamic. Now we are in trouble if we believe in Einstein's theory concerning the close coupling between space and time. The problem might be that *Einstein operates with coordinate systems which are undefined and time dependent.*

Question: How can space and time be the same kind of dimension so they can be combined in "Einstein-mode"?

2.4 Space dimension four 4

Do we have to introduce a fourth dimension in space so we have a fixed static XYZU-coordinate system? Again we have a system where we have to shortcut zero and infinite. The vector system becomes a tensor field. In this system, we may model both normal physical systems and systems beyond, i.e. metaphysical systems. Maybe we can model observations concerning the concepts of Ghosts, Clairvoyance, and Telekinesis.

Question: Do we influence the subjects of our observation?

In physics, we have the concept of *Complementarity*, i.e. the principle that objects have complementary properties that cannot all be observed or measured simultaneously because the observation process influences the object under observation.
It is impossible to observe both the wave and particle aspects of an electron simultaneously. A physical phenomenon expresses itself differently depending on the experimental setup used to observe it (Niels Bohr). The investigation process influences the result of the investigation.

3 Arithmetic

With reference to Wikipedia cite: "Arithmetic is a branch of mathematics that consists of the study of numbers, especially the properties of the traditional operations on them addition, subtraction, multiplication, and division. Arithmetic is an elementary part of number theory, and number theory is considered to be one of the top-level divisions of modern mathematics, along with algebra,

Classic arithmetic is operating with real numbers. Maybe we can obtain a better understanding and maybe introduce more kinds of numbers through using the rules on the special numbers zero (0), infinite (∞), and one (1)?

Here comes simple expressions for addition (+), subtraction (-), multiplication (*), and division (/). Question-marks indicate a problem to be discussed. No question-mark indicate an obvious relationship.

3.1 Addition and Subtraction

The basic rules are a + b = c and a - b = c

0 + 0 = 0	0 + ∞ = ∞	0 + 1 = 1
∞ + 0 = ∞	∞ + ∞ = ∞	∞ + 1 = ∞
1 + 0 = 1	1 + ∞ = ∞	1 + 1 = 2
0 - 0 = 0	0 - ∞ = ∞	0 - 1 = -1
∞ - 0 = ∞	∞ - ∞ = 0	∞ - 1 = ∞
1 - 0 = 1	1 - ∞ = ∞	1 - 1 = 0

Table 1: Addition, Subtraction

Addition and Subtraction do not give rise to any problems?

3.2 Multiplication

The basic rule is a*b = b*a = c from which b = b = c/a and a = a = c/b

0 * 0 = 0	0 * ∞ = 1 ?	0 * 1 = 0
∞ * 0 = 1 ?	∞ * ∞ = ∞	∞ * 1 = ∞
1 * 0 = 0	1 * ∞ = ∞	1 * 1 = 1

Table 2: Multiplication

We have a problem with the multiplication of zero and infinite. Will the result be 1, zero, or infinite? Are zero stronger than infinite or vice versa? Zero and infinite must have the same strength. If we have nothing and multiply with infinite it might be that we have something. If we have everything and multiply with zero it might be that we have something left. The conclusion seems to be that the multiplication of zero and infinite is one.

3.3 Division

The basic rule is a/b = c from which a = b*c and b = a/c

We have problems with division by zero and division by infinite.

0 / 0 = 1 ?	0 / ∞ = 0 ?	0 / 1 = 0
∞ / 0 = 1 ?	∞ / ∞ = 1 ?	∞ / 1 = ∞
1 / 0 = ∞ ?	1 / ∞ = 0 ?	1 / 1 = 1

Table 3: Division

3.4   Division by zero

Division by zero is not allowed in classic arithmetic. Here this may be questioned with the following arguments.

Given two finite numbers, A and B. Division is defined as: A / B = C where C is the result of the activity. From this relation, we may conclude that B * C = A, i.e. the multiplication of C with B is equal to A. If A = B then C = 1. Now A = B = x a very little number. What happens if we let this little number x go to zero? The result seems to be that zero divided by zero is equal to one: 0 / 0 = 1.

We have a problem with infinite divided by zero. If the result is one then infinite is equal to zero.

Other aspects of zero divided by zero:

Nullity, a concept in transreal arithmetic denoted by $\psi = 0 / 0$ [4].

In IEEE floating-point arithmetic: 0 / 0 = NaN, i.e. Not a Number, so that computer programs can operate properly.

Elsewhere zero divided by zero is defined differently from one. With reference to Wikipedia zero divided by zero is an "Indeterminate form" [5] [6]. It is not a number, NaN. The systematic use of NaNs was introduced by the IEEE 754 floating-point standard in 1985 [5].

James Arthur Dean Wallace Anderson Known as James Anderson is an academic staff member in the School of Systems Engineering at the University of Reading, England [4] [6]. He has written two papers on division by zero and has invented what he calls the "Perspex machine".

3.5 Division by infinite

Given two finite numbers, A and B. Division is defined as: A / B = C where C is the result of the activity. From this relation, we may conclude that B * C = A, i.e. the multiplication of C with B is equal to A. If A = B then C = 1. Now A = B = X a very large number. What happens if we let this large number X go to infinite? The result seems to be that infinite divided by infinite is equal to one: ∞ / ∞ = 1

We have a problem with zero divided by infinite. If the result is zero then zero divided by zero becomes infinite and not one.

4 Continuity

We have problems with understanding our model.

We may ask a large number of questions to be discussed. Is it true that the distribution of numbers on the number line must be continuous? What is the concept of continuous? If we introduce the distance between two numbers as (the first number minus the second number) where the first number is closer to plus-infinite than the second number, then the distance is positive or zero. How to introduce the concept of neighbor numbers which are different and with distance zero? Do we have to introduce new kinds of numbers?

The number (6.000000...) is the same as (5.999999...). If the number-line is continuous, then these numbers are neighbors and we need a reference point of size zero to separate the numbers. We have to introduce numbers and reference points having the same properties as zero and infinite. We may call these numbers Trans-real numbers [6].

5 Time

What is the concept of time? We introduce time so the model becomes dynamic. The model of the numbers is static in space. Do we have to introduce time so a dynamic model of numbers occurs ?. If so will our "physics" language become a "metaphysics" language?

Our thoughts are created at this very moment. When we are aware of our thoughts they are in the past. When we think of other people reading our thoughts they are

in the future. In short, we are alive and we are conscious about ourselves as a part or subset of our universe.

We invented the concept of time "T" because we observed oscillations in our environment. Time intervals (periods) like day, night, month, and year were found by observation of the behavior of the moon, the sun, and the stars.

We live in this very moment, which is the border between the future and the past. The size of the border is zero. When we become conscious about this very moment we are in the past. We do not know why our environment (universe) is oscillating. We do not understand the concept of time "T". We set up mathematical models of our environment. These models are dynamic because we introduce the mathematical time "t". The universal time "T" is much more complex than the mathematical time "t". We must admit that we do not understand the two time concepts.

6 Religion

All human beings has the same genetics. Because of that all religions has something in common. We observe pyramids in Egypt and in America. These pyramids are tetrahedrons. In Egypt the surfaces are plain. In America the surfaces are stairs. You may consider the top point the Eye of God an the points of the bottom triangle: Zero, One, and Infinite.

Question: Is God behind our creation of Mathematics?

Question: If you believe in something, will this something be a kind of Religion?

Atheists believe in "No God". An Atheist becomes very angry, if you claim he is religious ;-) !

7 Conclusions

We have severe problems with our assumptions, definitions, and understanding of the models and the concepts, we introduce based upon our observations.

We do not understand the concepts of zero (0) and infinite (∞).

We believe we understand the concept of one (1)..

We do not understand the concept of a number with an infinite number of digits.

We may introduce the infinite number circle model for which all numbers are modeled as geometric points with no area. We may introduce Trans-real numbers so the "distance" between two numbers becomes zero when they are neighbors. This may imply that zero and infinite are equal at the same time. In other ways, our model of the universe must be meta-physical. Our basic physical universe is static in three dimensions. We introduce time so the model becomes dynamic. The universal time "T" is much more complex than the mathematical time "t". We must admit that we do not understand the two time concepts.

8 Acknowledgements

References

[1] Erik Lindberg, "The Oscillator Principle of Nature - A simple Observation", NDES'2012, Nonlinear Dynamics of Electronic Systems 2012, Wolfenbüttel, Germany, Proceedings pp.50-53. Available from erik.lindberg@ieee.org

[2] https://en.wikipedia.org/wiki/MainPage

[3] https://en.wikipedia.org/wiki/Three-torus-model-of-the-universe

[4] https://en.wikipedia.org/wiki/James.A.D.W.Anderson

[5] https://en.wikipedia.org/wiki/Indeterminate-form

[6] Tiago S. dos Reis, Walter Gomide, James A.D.W. Anderson, Construction of the Transreal Numbers and Algebraic Transfields, *IAENG International Journal of Applied Mathematics*, **46:1** (15 February 2016).