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An Alternative Algorithm on Calculus and Error Management in GPS

Till Meyenburg

Citizen Scientist, Fachinformatiker IHK
Vorgebirgstrasse 332, 50969 Cologne, Germany

Abstract: *Global positioning systems have been a great benefit for mankind. The work behind the scenes is still ongoing and we still have theoretical issues. One issue is that a pure satellite driven system is unable to provide a proper GPS. We had to build groundstations. Independently from this problem, the author developed in 2015 an alternative algorithm on calculus that delivers for polynomials of first or second grade the same results, but slightly differs on polynomials of higher grade. In this manuscript, this alternative algorithm is put into tensor analysis. Albert Einstein uses tensors on general theory of relativity, so in this way we try to enhance error management in satellite-driven, three-dimensional GPS.*

Keywords: *Calculus, Newton, General Theory of Relativity, GPS, Tensor analysis*

I. Introduction

In a lecture held at the Bad Honnefer Industriegespräche by German Physicists Association DPG, scientists from the German Aerospace Association DLR told the publicity about a problem in global positioning systems like GPS or the European Galileo. Though the scientists are sure to have applied Einstein's special and general theory of relativity properly, there are still deviations on satellite driven three-dimensional GPS. Therefore ground stations had to be built, because in a 2-dimensional sphere like the surface of earth, it all works. [1]
This manuscript provides the alternative algorithm on calculus $f'(x) = \mathrm{Real}(f(x + i) * -i)$ with i being the square root of -1. In a corollary style, it is shown that this algorithm has no deviations on one- or two-dimensional polynomials and that with the third dimension, there come several non-standard terms that could be able to explain the deviations in GPS.

II. Explanation of the basic calculations in GPS

The basic calculations in GPS or Galileo consider Einstein's equations on time dilation. There are effects from special relativity and from general relativity. Combining the two equation systems, you can derive from time signals sent by satellites the 3-dimensional position on earth's surface. So well in theory and due to special relativity, the satellites experience a time dilation due to their high velocity. On the other hand, due to general relativity, they are far out of earth's gravity system, so time moves faster. On these signals, the position can be determined. As Einstein has always been proven right, the problem seems unsolvable. The solution in this paper keeps Einstein correct and has deviations on Newton's and Leibniz's calculus. This would mean, we have deviations in the tensor analysis of general relativity. In particular, the second derivatives of the space coordinates leading to the acceleration due to $a(t) = s''(t)$ and to the Forces will provide other results than in Standard Analysis.

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III. The alternative algorithm on calculus

The alternative algorithm begins with Newton's way of calculus. Everyone knows $f'(x) = (f(x + h) - f(x))/h$. The idea now is to substitute the h, which is tending to zero, by imaginary unit i. This idea came from deep thoughts about division by zero and similarities in the number 0 and imaginary unit i. So Newton's equation becomes $f'(x) = (f(x + i) - f(x))/i$ which leads because of $1/i = -i$ to $f'(x) = (f(x + i) - f(x)) * -i$. We will now show in a corollary way that this equation which can be for especially educational purposes simplified to

$f'(x) = Re(f(x + i) * -i)$

fulfills real derivation for polynomials of first and second grade. By the way, this as well is based on Professor Saburoh Saitoh's geometrically derived assumption 1/0 = 0.[2]

Corollary 1.1.

Let: $f(x) = ax + b$ or $f(x) = ax^2 + bx + c$

be either a linear or a quadratic function for $x \in R$. Then:

$f'(x) = Re((f(x + i) - f(x))(-i))$

Proof:

We start with the left handed side:

$f'(x) = a$ or $f'(x) = 2ax + b$

For the right handed side of the proposition we have:

$f'(x) = (a(x+i)+b-ax+b)(-i)$ or $(a(x+i)^2 +b(x+i)+c-ax^2 +bx+c)(-i)$

which yields:

$f'(x) = (ax + ai + b-ax-b))(-i)$

or

$f'(x) = (ax^2 + 2aix-a + bx + bi + c-ax^2 -bx-c)(-i)$

resulting in:

$f'(x) = (ai)(-i)$ or $f'(x) = (2aix-a + bi)(-i)$

and finally:

$f'(x) = a$ or $f'(x) = 2ax + ai + b$

The real part of the last equation is exactly the derivation of f(x).

Because of $-f(x) * -i$ being always imaginary for real functions, the term

falls away in the real setting. This leads to $f'(x) = Re(f(x + i) * -i))$.

4 Several possible deviations on polynomials of third grade

In concordance to the last sentence, there are several possibilities in polynomials of third grade. By simply continuing the corollary, looking at $ax^3 + bx^2 + cx + d$:

$f'(x) = Re(a(x + i)^3 + (b(x + i)^2 + cx + ci + d) * -i)$

$= Re(a(x^2 + 2ix + 1)(x + i) + b(x^2 + 2ix + 1) + cx + ci + d)$

$= Re(ax^3 + 3aix^2 + 2ax + i + bx^2 + 2bix + b + cx + ci + d) * -i)$

$= 3ax^2 + 2bx + c + 1$

the reader sees in this simple example that you get a plus one in calculus of third grade polynomials. What's the amount of this plus one in physics has to be seen in GPS deviation.

5 Implications of the new algorithm on tensor analysis

In Tensor Analysis as the team understands, 3 dimensions x,y,z are taken with functions of polynomial third grade and derive it two times partially to get the gradient as the largest amount. This is historically combined with the principle of least resistance that the three dimensional path always follows the coordinate with the highest growth or decrease. The reader can imagine this by a lightning strike.

In lacking enough data, the team has to stay in general. So the author follows the corollary and simply puts the last result again to the new, alternative algorithm of calculus.

$f''(x) = Re((3a(x + i)^2 + 2b(x + i) + c + 1) * i)$

$= Re((3ax^2 + 6aix + 3a + 2bx + 2bi + c + 1) * -i)$

$= 6ax + 2b$

Thus this delivers same result with 0*0=1. On the 2nd calculus of three-dimensional polynomials, we have no deviation. How about letting the imaginary amounts in the first calculus stay.

$f''(x) = Re((3a(x + i)^2$

$-2a(x + i) * i + 2(b + i) - bi + c + 1) * -i)$

$= Re((3ax^2 + 6aix - 3a - 2axi + 2a + 2b + 2i - bi + c + 1) * -i)$

$= 6ax - 2ax + 2b - b$

$= 4ax + b$

This is the possible deviation according to the alternative algorithm of calculus.

It would prove that 0*0=-1. It has to be decided whether to set it to complex numbers or hyperbolic complex numbers and then substitute the limit to zero with i, so the scientific community can be sure that to at least provide a better algorithm by substituting zero by i according to 0*0 = 1 as to substitute zero by epsilon or h in Newton's and Leibniz calculus. If hyperbolic complex numbers are assumed with i*i=+1, the solution will be

$f''(x) = 8ax + 3b$

IV. Results

The community can see in this short evaluations that the author and his team try to use other solutions on 0 * 0 than 0 * 0 = 0. This comes from the insight that the team assumes 1/0 = 0 as 1/i= i in the hyperbolic complex number set. With simple arithmetical and algebraic thoughts, the team draws conclusion to the connection of 0/0 = 0 * 1/0 = 0 * 0. With the same accordancy, the team uses Rule of l'HOSPITAL on 0/0 in functional analysis, and advises it should be used in an according manner rule on 0 * 0. So the community is able to see that 0 * 0 = 0 is only a special case of 0 ∗0 = r with r element of real number set as we see the resultset of rule of L'HOSPITAL on 0/0 equals r. And we see on problems with distributivity that 0/0 = 0 * 0 = 1 with the precedence rule that the zeros have to be evaluated first is a valid rule in analysis. And the deviations just begin on three dimensions or on second derivative so no one noticed so far because the error was minimized. This could help solve the application scenario of String Theory.

V. Outlook

The division by zero or generally to evaluate the zeros has been a major part of the interpretations on theory of relativity, so physics will be included in these advances. And physics delivers great insights, too, like constancy of light speed which shows other algebras on reality than our common and will work out the last standing problem of distributivity.

VI. References

[1] Weblink in German on 02.05.2023: https://www.magicmaps.de/gnss-wissen/wie-funktioniert-gps/?L=0.

[2] Sabouroh Saitoh, https://vixra.org/pdf/1908.0100v1.pdf, page 6.

[3] For the same result on 0/0, see Barukcic, International Journal of Mathematics Trends and Technology (IJMTT), Volume 65, Issue 8, August 2019, page 41, equation (71).