

The Infinity Computer

“Mathematicians have never been comfortable handling infinities... But an entirely new type of mathematics looks set to by-pass the problem... Today, [Yaroslav Sergeyev](#), a mathematician at the University of Calabria in Italy solves this problem... ”

[MIT Technology Review](#)

A technology provided by

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The problem

- **Nowadays physical limits (speed, miniaturization) of traditional computers have been almost reached.** Current attention of the industrial and scientific communities is dedicated to new computational paradigms and areas of their possible applications.
- In spite of huge investments, **there do not exist on the market general purpose unconventional computer architectures ready for a broad implementation and production.** For instance, industrial quantum general purpose computers do not exist (D-Wave is not general purpose).
- **Traditional computers work with finite numbers only.** Numerical computations with infinities and infinitesimals are impossible due to:
 1. the presence of indeterminate forms such as $\infty - \infty$, ∞ / ∞ , $\infty \cdot 0$.
 2. the impossibility to put infinite numbers in the finite computer memory.
- **There exists an insuperable wall in performance beyond which traditional computers are not able to go** and all kinds of divergences and usage of infinitesimals can be studied only analytically by human beings.

Grossone[®] Infinity Computer

- **The Infinity Computer is a new kind of a supercomputer able to execute numerical computations with finite, infinite, and infinitesimal numbers using a new numeral system with the infinite radix called Grossone[®] and expressed by the symbol ①.**
- An analogy: Ancient Romans did not know about existence of zero and negative numbers. As a consequence, they were not able to execute computations requiring these numbers and such expressions as V-V or III-X were indeterminate forms for them. In modern computations 0 is indispensable and the work of traditional computers is impossible without zero and negative numbers.
- The Infinity Computer makes a similar thing thanks to Grossone[®] making possible **the passage from finite numbers to infinities and infinitesimals** and allows consumers to work numerically with different infinities and infinitesimals as with finite numbers giving so to the consumers **an unprecedented level of accuracy and power of computations** that does not exist on the market.

Grossone[®] Infinity Computer

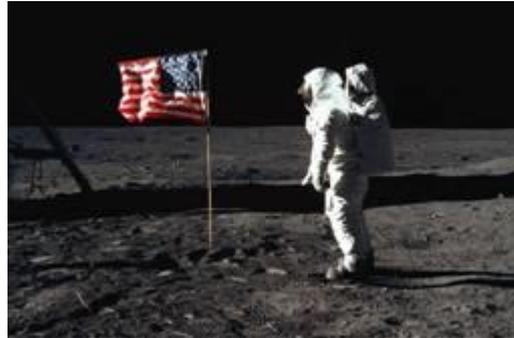


Yesterday: the Pirahã tribe from Amazonia uses 1, 2, many to count:

$1 + 2 = \text{many}$
 $\text{many} + 1 = \text{many}$
 $\text{many} + 2 = \text{many}$



The traditional work with infinity is primitive. Pirahã cannot count beyond 2 whereas we distinguish many different finite numbers.



Today: we use the symbol ∞ to work with infinity and astronauts from NASA walked on the moon

$\infty + 1 = \infty$
 $\infty + 2 = \infty$



Grossone[®] gives the possibility to distinguish many different infinities and infinitesimals.



Tomorrow: using $\textcircled{1}$ we'll fly to stars and beyond

$\textcircled{1} + 1 > \textcircled{1} > \textcircled{1} - 1$
 $9.3\textcircled{1} - 5\textcircled{1} = 4.3\textcircled{1}$
 $7\textcircled{1} / 2\textcircled{1} = 3,5$
 $6\textcircled{1}^{2.3} \cdot 5\textcircled{1}^{-1.7} = 30\textcircled{1}^{0.6}$

Scientific prizes, plenary lectures, and mass media attention to the technology confirm that we face a real breakthrough

- [Khwarismi International Award, Iran](#)
- [EUROPT Fellow](#)
- [Honorary Fellowship, the highest distinction of the European Society of Computational Methods in Sciences, Engineering and Technology](#)
- [Pythagoras International Prize for Mathematics, Italy](#)
- [Outstanding Achievement Award from the World Congress in Computer Science, Computer Engineering, and Applied Computing, USA](#)
- [Lagrange Lecture, Turin University](#)
- More than 60 plenary lectures and tutorials around the globe
- Member of editorial boards of 8 international scientific journals
- Chairman of 11 international congresses
- [Russian 1st TV Channel](#), [Russian TV Channel “Culture”](#), [ITAR-TASS](#), [MIT Technology Review](#), [New Scientist](#), [Russia Beyond the Headlines](#), etc.

Value Proposition and Competitive Advantage

- **Market is the entire market of digital processors** including microprocessors, devices for digital elaboration of signals, simulators, scientific calculators, etc.
- **The Infinity Computer is a radical innovation**, not an incremental one. It opens a new era in the whole world of computing.
- **Strategic advantage: In the modern world the power of computation can cause victory or defeat of a firm or a country.** The Infinity Computer with its supercomputing capabilities gives a **strategic advantage to its owner**.
- **There exists its working software prototype and the hardware can be done in several months** (see patents: [USA 7,860,914](#), [EU 1728149](#), and [Russian 2395111](#)).
- The Infinity Computer **drastically increases the accuracy of computations** by substituting qualitative descriptions of the type 'a number tends to zero' and 'a number tends to infinity' by a variety of different infinities and infinitesimals.
- The Infinity Computer **avoids divergences and indeterminate forms** ($\infty - \infty$, $0 \cdot \infty$, ∞ / ∞ , etc.) and gives the possibility to work numerically with actual infinite and infinitesimal numbers.
- The Infinity Computer leads to **new models describing the world around us in a more precise way** and simplifies teaching mathematics at schools and universities.

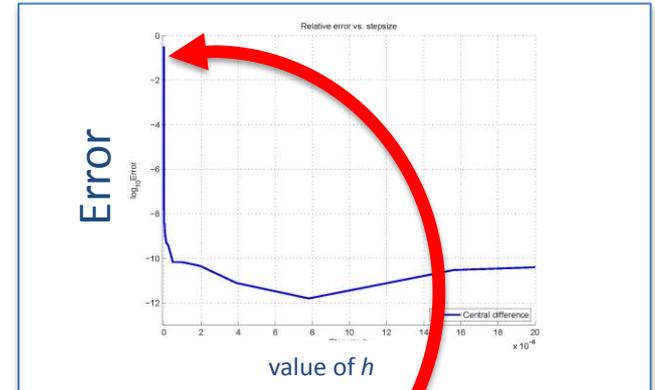
Sinergy instead of competition

- The Infinity Computer will take advantage of no direct competition in its business segments:
 - it will be proposed as a complementary and synergic product** with respect to the ones offered by current players on the market.
- **The potential competing companies will be converted into customers** and become a shortcut to Infinity Computer market penetration, in particular:
 - already existing computation software companies are looking for new toolboxes to be included in their software packages.
 - microprocessor vendors should welcome the introduction of new functionalities in their products.
 - In both cases the Infinity Computer will represent the piece of innovation suitable to bring these products a next step ahead.

An application example

To compute a numerical approximation of **only one** derivative $f'(x)$ traditional computers **execute many runs** with different values of h and can obtain **approximate results only**

$$f'(x) \approx \frac{f(x+h) - f(x-h)}{h}$$



To improve the accuracy of numerical approximation it is necessary to decrease h but for very small values of h **the error EXPLODES**



The Infinity Computer executes just **one run** and obtains **the exact results** for **all desired derivatives***.

* For details see: Sergeyev Ya.D. (2011) Higher order numerical differentiation on the Infinity Computer, *Optimization Letters*, 5(4), 575-585.

Opinions of experts expressed in international scientific journals

- “These ideas and future hardware prototypes may be productive in all fields of science where infinite and infinitesimal numbers (derivatives, integrals, series, fractals) are used.” A. Adamatzky, Editor-in-Chief of the [International Journal of Unconventional Computing](#).
- “By introducing a new infinite unit... he shows that it is possible to effectively work with infinite and infinitesimal quantities and to solve many problems connected to them in the field of applied and theoretical mathematics.” R. De Leone, President of the Operations Research Society of Italy (2007-2012), [Applied Mathematics and Computation](#).
- “I am sure that the new approach ... will have a very deep impact both on Mathematics and Computer Science.” D. Trigiante, [Computational Management Science](#).
- Though in the past we had no numerical tools suitable to deal with infinite, finite and infinitesimal quantities, this is no longer the case since the introduction of Sergeyev’s Infinity Computing, L. Fiaschi, M. Cococcioni, [International Journal of Unconventional Computing](#).

Contact information



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