Research (What is it about?)	**Infinity computer for solving initial value and fractals problems**
UNN authors	*Sergeyev Ya.D., Mukhametzhanov M.S.*
We find (The result)	On the basis of ***Infinity Computer*** the new methods for solving initial value problems and fractal calculation have been developed which are significantly more accurate than the existing ones.
Abstract	It is well known that numeral systems strongly bound the possibilities to express numbers and to execute mathematical operations with them. In order to give the possibility to write down more in finite and infinitesimal numbers, a new numeral system has been introduced. It allows people to express a variety of different infinities and infinitesimals, to perform numerical computations with them, and to avoid indeterminate forms such as ∞-∞, ∞/∞, 0•∞, etc. present in the traditional calculus and related to limits with an argument tending to ∞ or zero. This new numeral system is based on the introduction in the process of computations of a new numeral, ***grossone***. It is defined as the infinite integer being the number of elements of the set, N, of natural numbers. On the basis of this numeral system a new kind of a supercomputer – the Infinity Computer has been developed – that is able to deal numerically with finite, infinite and infinitesimal numbers. Due to this fact, the Infinity Computer allows one to calculate the exact parameters of fractals or the exact derivatives of functions using infinitesimal values of the stepsize. As a consequence, the new methods are able to work with the exact values of the derivatives, instead of their approximations. As an example the fractal problem is solving by calculation the exact (up to infinitesimals) infinite perimeter of the Koch snowflake and its finite area. New algorithms for the numerical solution of ordinary differential equations with initial condition demonstrate significantly greater accuracy than the existing ones.

Representative articles 2016-2017, quartiles	1. *Sergeyev Ya.D.* The exact (up to infinitesimals) infinite perimeter of the Koch snowflake and its finite area. Commun. Nonlin. Sci. and Num. Simul. **31**(1–3), 21–29 (2016). 2. *Sergeyev Ya.D., Mukhametzhanov M.S., Mazzia F., Iavernaro F., Amodio P.* Numerical methods for solving initial value problems on the Infinity Computer. Intern. J. Unconvent. Comput. **12**(1), 3–23 (2016).	Q1 Q3
	Q-index (Qi) of the result	**3**

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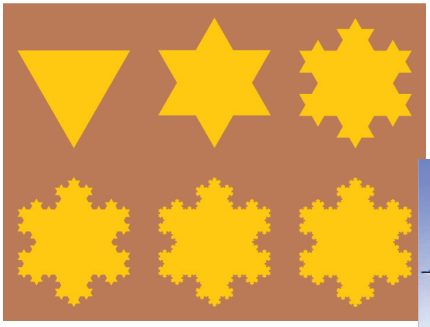
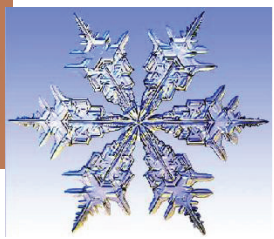


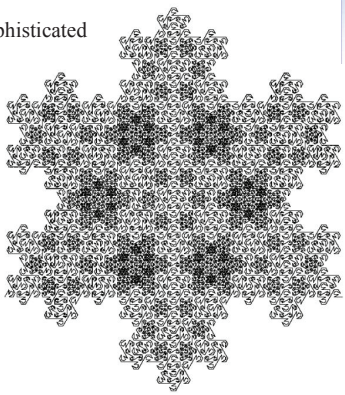
Generation of the simple two-dimensional fractal (the Koch snowflake). All its parameters can be calculated exactly by Infinity Computer.

Further …



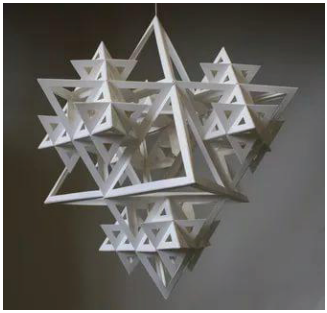
natural,

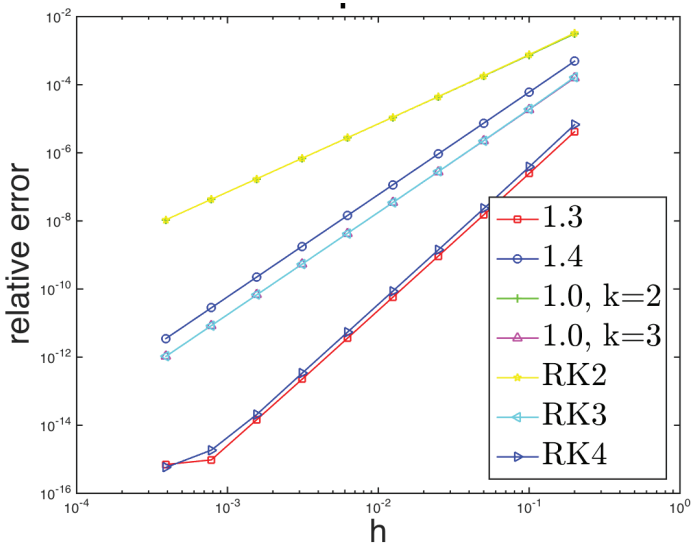
more sophisticated



ones.

and three-dimensional





New algorithm with the exact values of the derivatives (red line) allows one to reduce the error significantly with respect by classic Runge-Kutta methods (RK) at the same stepsize (h).