

# New computational methodology gives unexpected answers to two Hilbert problems

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A paper titled "Numerical infinities and infinitesimals: Methodology, applications, and repercussions on two Hilbert problems," published in *EMS Surveys in Mathematical Sciences* describes a recent computational methodology related to the separation of mathematical objects from numeral systems involved in their representation. It allows mathematicians to work with infinities and infinitesimals numerically in a unique computational framework in all situations requiring these notions. The methodology does not contradict Cantor's, and is based on Euclid's Common Notion no. 5, "The whole is greater than the part," applied to all quantities (finite, infinite, and infinitesimal) and to all sets and processes (finite and infinite). The non-contradictory of the approach has been proven by Italian logician Prof. Gabriele Lolli.

This computational [methodology](#) uses a new supercomputer, the Infinity Computer, working numerically, as opposed to traditional theories that work with infinities and infinitesimals only symbolically. It processes infinite and infinitesimal numbers that can be written in a positional numeral [system](#) with an infinite radix. The Infinity Computer drastically changes the entire panorama of numerical computations, enlarging horizons of computational possibility to different numerical infinities and infinitesimals. It is argued in the paper that numeral systems involved in computations limit computing capabilities and lead to ambiguities in theoretical assertions, as well. The new methodology makes it possible to use the same numeral system for measuring infinite sets, working with divergent series, probability, fractals, optimization [problems](#), numerical differentiation, ODEs, etc.

In particular, the new approach allows researchers to observe [mathematical objects](#) involved in the Hypotheses of Continuum and the Riemann zeta function with a higher accuracy than traditional tools. The difficulty of both problems is a consequence of the weakness of traditional numeral systems used to study them. The effect of employing the new methodology in the study of the above Hypotheses is comparable to the dissolution of computational problems posed in Roman numerals (e.g.  $X - X$  cannot be computed in Roman numerals since zero is absent in their numeral system). More papers on a variety of topics using the new computational methodology can be found at the Infinity computer web page: <http://www.theinfinitycomputer.com>

Provided by Lobachevsky University

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