

# Grossone Infinity Computing: Foundations

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This tutorial introduces a new methodology (different from non-standard analysis theories) allowing one to execute *numerical* (not symbolic) computations with finite, infinite, and infinitesimal numbers (see surveys [1, 2] and a semi-popular introduction in [3]). These numerical computations can be executed on a new type of a computational device – the Infinity Computer (see patents [4]). The new approach is based on the principle ‘The part is less than the whole’ introduced by Ancient Greeks and applied to all numbers (finite, infinite, and infinitesimal) and to all sets and processes (finite and infinite).

The new methodology examines in detail the difference between mathematical tools used to describe mathematical objects and the objects themselves. In particular, it is stressed that numerals we use to write down numbers (finite, infinite, and infinitesimal) are among our tools and, as a result, they strongly influence our capabilities in studying numbers. A variety of numeral systems including numerals used by Cantor and numerals introduced in [1–3] are compared from several points of view. The concept of *accuracy* of mathematical languages and its importance for a number of theoretical and practical issues regarding computations is discussed. Numerous examples and applications are given. The Infinity Calculator using the Infinity Computer technology is presented.

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## References

- [1] Sergeyev Ya. D. (2008) A new applied approach for executing computations with infinite and infinitesimal quantities. *Informatica*, Vol. 19 (4), pp. 567–596.
- [2] Sergeyev Ya. D. (2010) Lagrange Lecture: Methodology of numerical computations with infinities and infinitesimals, *Rendiconti del Seminario Matematico dell’Università e del Politecnico di Torino*, Vol. 68(2), pp. 95–113.
- [3] Sergeyev Ya. D. (2003) *Arithmetic of Infinity*. Edizioni Orizzonti Meridionali, CS.
- [4] Sergeyev Ya. D. Computer system for storing infinite, infinitesimal, and finite quantities and executing arithmetical operations with them. *EU patent 1728149*, issued on June 03, 2009; *RF Patent 2395111*, issued 20.07.2010; *USA patent 7,860,914*, issued 28.12.2010.