

Review on the manuscript of Hans Grassmann:

A new method for division and factorization based on inverse computing
(Prolegomena to a physics of information)

- 1) Review of Fabiano Bet
- 2) Anonymous review
- 3) Anonymous review
- 4) Comments by the editor

1) Reviewer: Fabiano Bet

Field of competence: high performance computing, computational physics

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The article finds the explanation for a strange phenomenon, which has never been understood before: from a mathematical point of view division is the inverse of multiplication. Computer programs for multiplication and division instead are fundamentally different from each other. This difference is not only of a philosophical or academic nature, but is also of great practical importance: public key cryptography is based on it.

The article then shows, that one can create a multiplication algorithm, which shows the mathematical structure of multiplication by making use of the fact, that multiplication can be seen as a category. Now, division can be done by running this same algorithm backwards.

The article then proceeds to argue, that the same kind of argument can be made with respect to factorization, since also the prime factors and their products form isomorph sets. Therefore it should become possible in the future to factorize prime products by means of algebra, instead of the currently used trial and error procedure.

It is of particular interest that these arguments have been obtained from a physics point of view - if one considers information processing as a physics process occurring in the physical world, then there should be a field of physics describing it, and therefore there should be some underlying mathematical structure involved, like in all fields of physics.

This is different from state of the art science: artificial intelligence for example is not based on mathematical structure, but rather attempts to overcome the lack of mathematical structure by means of multi parameter fits, based on statistical distributions.

The author has argued in his first book, about 25 years ago, that physics must be rooted in culture to be productive. In particular, physics and democracy are correlated and should be allies. The article is a new example for this situation: the first steps towards a physics of information were stopped in 1933, it

would indeed be good to reconstruct what was destroyed then and to continue it. Arguments of this kind should be discussed more in the scientific community.

2) Anonymous review previously sent to the Journal of Formal Logic

A review

on the manuscript of Hans Grassmann “A new method for division and factorization based on inverse computing (Prolegomena to a physics of information).

An interesting interpretation of a mathematical structure for the multiplication of natural numbers is presented. This structure permits us to consider division as an inverse of the classical multiplication algorithm. The script of such an approach is provided. The main drawback of the manuscript is that the author **has not investigated and reported the time-complexity of his algorithm**. This can be easily done by Monte Carlo simulations with, e.g., the help of the R-package “microbenchmark”.

Numerous algorithms of division with the complexity $O(n^2)$ or less are known and everybody is interested to compare the complexity of the proposed algorithm with those achieved by the date. From the above it follows that **the manuscript needs a revision**. Except this main suggestion there are some other comments:

- 1) On p.2 of Section 4) the author writes that “important classical questions about ... how are the prime numbers distributed ... are hardly structural”. Today we know that this structure can be extracted from the congruence (2) of Agrawal et al. (2004) [1].
- 2) On the top of p.6 the author writes that “a physical device organized as in Fig.1 cannot be inverted (public key cryptography is based on this fact)”. Actually, Voinov (2023) [2] demonstrated a simple polynomial-time algorithm that inverted the product n of two primes p and q ($n=pq$). The question arises – whose algorithm is better? Again **the author has to investigate the complexity** of his interesting algorithm of Appendix 1.

References:

1. Agrawal M., Kayal N., Saxena N. (2004) Primes is in P. *Ann. Math.* **160**, 781-793
2. Voinov V. (2023) A simple enumerative polynomial-time algorithm for the prime factorization. *CABJ* **23**(2), 1-6, <https://doi.org/10.55861/cabj.23.02.01>

3.04.2025

Comments

On the revised version of the manuscript of Hans Grassmann “A new method for division and factorization based on inverse computing (Prolegomena to a physics of information).

Being not a specialist in physics’ philosophy and its relation to mathematics, I cannot assess the first three sections of the manuscript. As for mathematical part, I would say that it is a valuable contribution to computer science, even without a desired investigation of the proposed algorithm’s complexity.

In view of the above, I suggest considering the following decisions’ variants:

- 1) Exclude the mathematical part and publish it separately,
- 2) appoint a referee who can assess the philosophical part and, depending on his/her decision, publish or not the whole manuscript. Personally, I’m in favor of option 2. Note that a published version should not contain number 7) for two different sections.

In any case, the proposed or some other final decision is up to the Editor!

A reviewer

28.04.2025

3) Anonymous review previously sent to the Journal of Formal Logic

While this paper has many virtues, it is unfortunately not suitable for publication in NDJoFL.

The paper is explicitly programmatic. This poses natural problems for a standard research paper, but the problems here are more serious as there is already an extensive literature on physical computation, its structure, and its limitations. Much of this literature centers on issues like the physical Church-Turing thesis. The present paper does not engage with this literature.

The usual setup is as follows: (1) specify a physical theory (Newtonian mechanics with no bound on speed of energy or STR or GTR or the GRW formulation of quantum mechanics or something else), (2) specify a model for physical computation subject to the specified physical constraints, then (3) study what is computable and how given the computational model.

Much of the present paper discusses part of what step (2) might look like on a particular structural understanding physical computation. The reader, however, is left without much of philosophical import to show for working through the details.

4) Comments by the editor

The article "A new method for division and factorization based on inverse computing" was sent to the Journal of Formal Logic in May 2024. The results of their anonymous reviews are shown above.

The first review seems to be written by a mathematician, it says that the article is interesting, without going into any detail, only the first 3 lines refer to the reviewed article. Instead the reviewer demands a major rewriting because the article " **has not investigated and reported the time-complexity of his algorithm** " This requirement may reflect the scientific interests of the reviewer, but it has nothing to do with the article, which is a physics article, and time-complexity obviously is not a physics variable.

The second reviewer of the Journal of Formal Logic does not refer to the scientific contents of the reviewed article at all, instead he suggests that one should do research on different issues, not the ones discussed in the article. For instance he would like to see the Church-Turing thesis being discussed. A comprehensive discussion of the Church-Turing thesis can be found for instance at <https://plato.stanford.edu/entries/church-turing/> - evidently, the discussion has nothing to do with physics, again the reviewer effectively is saying that one should discuss only what interests him, and not things different from that.

Based on this review, the Journal of Formal Logic decided not to publish the article.

The decision process took more than 1 year, and in this time the anonymous reviewers have produced less than 3 lines of text referring to the reviewed article.

Those anonymous "reviews" can be compared to the non-anonymous review of Dr. Fabiano Bet. He is founder of the company INDESA GmbH, one of the few companies which actually make money from high performance computing, and is a leading expert in the field of physics simulation.

The comparison suggests, that science should not be anonymous.