

Intensification of a methodological approach for mathematical expressions using diverse software: A review study

G. Panneerselvam ^{1,*} and M. Priyadharsini ²

¹ Faculty on Contract, Department of Education, National Institute of Technology Puducherry, Karaikal-609609, India.

² Department of Science and Humanities, Bharathiyar College of Engineering and Technology, Karaikal-609609. India.

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Abstract

This current paper attempted to review the methodical intensification of diverse software to teach and learn mathematical expression. The intention is to use this software to solve and create dynamic visualization of expressions in 2D or 3D for various topics in mathematics. The difficulties in teaching mathematical expressions by conventional methods are replicated in this work, to which pertinent topics. One of the main issues, which should have some consequences, is the description of the difficulties in teaching mathematical expressions. It should be addressed with some findings and discussion; highlighted results are included to set the scene. To make the mathematics classroom transition between the topics and the session easier, the software system also presents mathematical language in a manner that is congruent with handwritten notations and textbooks. These elements emphasized that the educational system needed a paradigm change in technique, and the particular subsections would provide detailed justifications for the use of software to teach expressions. The exposures of certain topics in mathematics that assisted with the relevant software will then be drawn by different researchers and highlighted for better comprehension. To enable a software system, its modular architecture divides symbolic math software components from math display components. The relevant software undertaken is such as SciLab, Maxima, and Microsoft Mathematics, and some importance of this software is recorded with suitable themes. Thus, the theme includes the explosion of SciLab, Maxima, and Microsoft Mathematics, thus represented in text and diagrammatic format. Finally, a conclusion and recommendation insist on the specification of diverse software to perform calculations on expression in mathematics.

Keywords: Methodology; Mathematics; Software; Expressions; SciLab; Maxima; Microsoft Mathematics.

1. Introduction

Mathematical expressions have always been highly abstract and challenging for students, and they have more difficulty solving them with proper understanding. After collecting evidence for this, it is now widely acknowledged that the main goal of math instruction in schools should be to develop students' capacity for creative thought rather than rote memorization of math concepts [1]. This change should be possible only by representing required changes in pedagogical patterns. Thus pedagogy is a science in math education that plays a role in preparing teachers and supporting them while they teach the subject. It covers all of the instructional content that is employed, as well as the strategies, methods, theory, and practice of teaching, as well as the particular interactions between teachers and students. Salami & Okeke (2017) noted that research has consistently shown that mathematics teachers generally use teacher-centered methods to teach [2]. Instead of using specific methods, they perform math concepts with poor-quality instructional techniques. It is one of the major causes of poor achievement in mathematics [2]. Also, non provision of an activity-oriented and pupil-centered lesson, which could demystify the teaching and learning of the subject, is the main reason for the poor performance [2]. The fundamental premise is that there is a lack of comprehension in arithmetic, particularly about expressions. So in this review article, the data about mathematics software to solve expressions in

*Corresponding author: Panneerselvam. G

mathematical concepts will be focused. Thus math software is a tool, and it is the world's most powerful math engine with an interface that makes it extremely easy to analyze, explore, visualize, and solve mathematical problems [3].

Primarily this software is used to model, analyze, or calculate numeric, symbolic, or geometric data [4]. However, employing certain teaching strategies shouldn't be the only method to represent mathematical expressions; rather, mathematical software should be one of many tools that students may use to understand the concept more deeply and meaningfully. Accordingly, Hayden et al. (2018), generate several dynamic visualizations using the CAS to analyze and assess students' progress in acquiring mathematical ideas [5], whereas, CAS is computer algebra software with the ability to manipulate mathematical expressions in a way similar to the traditional manual computations in mathematics is performed [6], it includes SciLab, Maxima and Mathematics Software.

At last, this review paved the way for a more effective approach to performing mathematical expressions using the above-mentioned three software programs.

2. Establishing the context

There are two primary points of view that tutors using mathematical software for educational purposes must consider when it comes to teaching methodology. First, focus on how to utilize the right software for the right tasks—for example, selecting Microsoft Mathematics to derive or solve expressions in mathematics and mathematics relegated subjects. The second is how to become proficient in using the tools at our disposal to resolve certain mathematical issues from many fields of applied and general mathematics. In this review article, the authors discuss how the software is used to teach mathematical courses and share their observations about how teachers and students utilize it.

2.1 Challenges in teaching expressions

In teaching expressions in a traditional classroom, a teacher generally uses a teacher-centered method that mostly consists of lectures, or blackboard for the current case as a pedagogical approach. Hackman, (2004) reported that this pedagogical approach of placing the primary focus on the teacher as a transmitter of knowledge (that is, teaching by telling) is representative of behaviorist theory [7]. Sharndama, (2013) highlighted that mathematics, like other subjects, used to be taught by a teacher using a chalk-and-talk approach, whereby students learned just by listening to what the teacher was saying. Swan (2000) reported that some students complained that their math professors spoke too quickly and were unable to adequately explain mathematical ideas [8]. Beauchamp, (2004) revealed that to improve students' performance and skill development using interactive ICT technologies, teachers must abandon the traditional method of instruction and adopt a new interactive teaching and learning style [7]. There is a need to change the methodology used as the foundation for material delivery in light of some of the reviews that were highlighted previously.

2.2 Paradigm approaches to methodology

The focal point of the current work focuses mostly on mathematical expressions. For that, Computer Assisted Software (CAS) offers the right kinds of mathematical software programs that solve problems and provide visual aids for improved consideration. In the processing of reviewing data related to math software, [9] reported that SciLab and Maxima are general-purpose CA software's are non-commercial, and are appropriate for aspirants who need to concentrate more on expressions in Mathematics. Despite this, one of the programs that is currently available to work with expressions and equations of various degrees is Mathematics software. Overall, with the use of the three software programs mentioned above, students were able to integrate their prior knowledge and engage in hands-on learning, leading to a stronger comprehension of math concepts and cognitive ideas. However, tutors must put in a lot of preparation work to teach expressions using these programs, and they must educate students about it in contrast to other applications that deal with mathematics In this tenure, one of the researchers, Stefan (2012), shared his eight years of experience in using software's to teach Mathematics. It is observed that (i) how is software used in students' calculations, (ii) what mistakes disappeared and what mistakes appeared, (iii) how successful will be taking these subjects, and (iv) what kind of student's reaction and respond we got after using this kind of teaching[10]. In the closing part of his research, Valery (2015) acknowledges that by utilizing graphics and animation, one can significantly increase the understanding of pupils and students of the basic concepts and theorems of mathematics [11]. These sorts of techniques will enhance the arithmetic learning experiences of learners by consolidating the process of executing expressions in mathematics. These are some of the challenges that are raised over time dealing with mathematical expressions. As remedies, assisting software in the part of methodology will be reviewed in the forthcoming section.

3. Software's exposure

SciLab: It is a high-level, numerically oriented programming language and a cross-platform, free, and open-source numerical computing suite. The language provides an interpreted programming environment, with matrices as the main data type [12]. To manipulate matrix-based computation, SciLab is commonly used and it is a versatile tool that can be used to solve linear systems using the Gauss elimination method [13]. SciLab is a robust tool for 2D and 3D graphing that may be used in the classroom by students with no background in mathematics technology [14]. Even though it's a feature in Scilab, that documentation offers more assistance while using the program. This provision is called common operators, and it includes a list of common operators such as; addition (+), subtraction (-), multiplication (*), division (/), power (^), and complex conjugate transpose (') [15]. Some of the arithmetical symbols and their shortcuts involved in normal math equations can be elaborated below. Underscore(_), Square root($\sqrt{\quad}$), integral (\int), and so on. For instance, a screen grab of the equation used in the product of two matrices of 3X3 dimensions, created in SciLab, is shown below for easier comprehension.

The screenshot displays the SciLab on cloud interface. The navigation menu on the left includes:

- Main Category: 8 - Mathematics & Statistics
- Sub Category: 8 - Engineering Mathematics
- Book: 1 - Higher Engineering Mathematics (by B. S. Grewal)
- Chapter: 2 - Determinants and Matrices
- Example: 2.17 - Product of two matrices
- Revision: 1 - Initial commit / add all books

The result window shows the following output:

```

A =
  1.   3.   0.
 - 1.   2.   1.
  0.   0.   2.
B =
  2.   3.   4.
  1.   2.   3.
 - 1.   1.   2.
AB=
ans =
  5.   9.   13.
 - 1.   2.   4.
 - 2.   2.   4.
BA=
ans =
  - 1.   12.   11.
 - 1.   7.   8.
 - 2.   - 1.   5.
ly AB is not equal to BA

```

The Scilab code window shows the following code:

```

1 clear
2 clc
3 A=[1 3 0;-1 2 1;0 0 2]
4 B=[2 3 4;1 2 3;-1 1 2]
5 disp("AB= ")
6 A*B
7 disp("BA= ")
8 B*A
9 disp("clearly AB is not equal to BA")

```

Figure 1 Syntax representation of multiplication of two matrices

Maxima: Maxima is software for working with mathematical expressions that are next to SciLab. Edwin (2009) reported that Maxima is a potent computer algebra system (CAS) that integrates symbolic, numerical, and graphical capabilities, as noted by [16]. It is based on a Macsyma version from 1982. A multitude of methods for rearranging symbolic algebraic expressions are supported by Maxima, as is the case with most computer algebra systems: polynomial factorization, polynomial greatest common divisor, computation, expansion, division into real and imaginary parts, and conversion of trigonometric functions to exponential and vice versa [17]. Maxima is used to work with both symbolic and numerical expressions, such as sets, vectors, matrices, polynomials, ordinary differential equations, integration, differentiation, Taylor series, Laplace transforms, and systems of linear equations [18]. Even the most intricate expression patterns can be saved and algebraic expressions may be declared using the Maxima application. The learners may find the values of these expressions at certain, fixed parameter values, and they can be freely transformed. With Maxima, learners have complete control over computations and partial outcomes. All findings are presented in symbolic form for accurate reasoning analysis [19].

Mathematics Software: A suite of mathematical tools called Microsoft Mathematics may greatly enhance learners' mathematical performance and foster a deeper comprehension of concepts in calculus. This completely comprehensive program provides scientific support for all calculus topics, including powerful graphing and problem-solving tools. Oktaviyanthi (2015) states that simple instructions may be used to write, compute, and modify mathematical expressions in addition to creating 2D, 3D, and animated graphical representations [20].

To graph a calculus equation and illustrate a differential equation $\frac{d^2}{dx^2}(x^3 - 2x^2 + 10x + 4)$ may be calculated through this software. This processed equation can be taken by the software in the format, $\frac{d^2}{dx^2}(x^3 - 2x^2 + 10x + 4)$

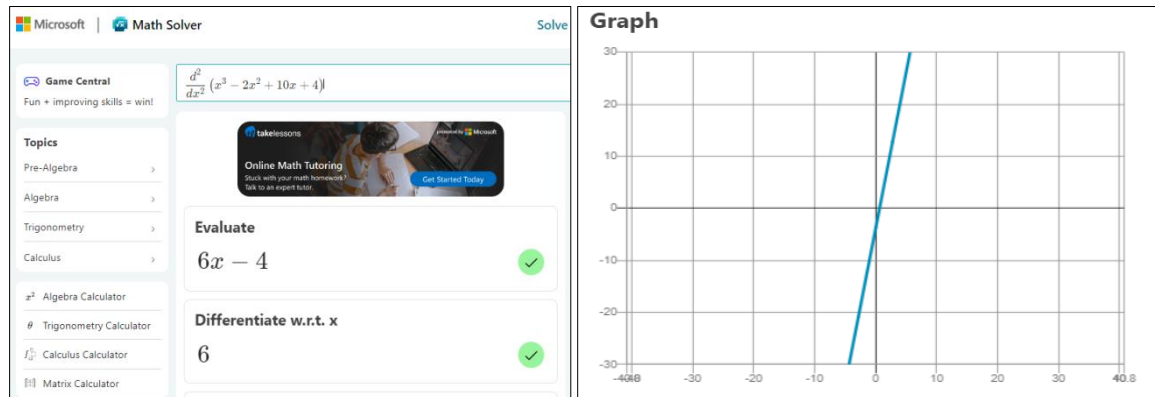


Figure 2 Representation of derivatives on Calculus in Graphical format

The procedures for solving the particular second derivative problem from Microsoft Mathematics that was previously stated are shown in Figure 2. For a clearer comprehension in the xy -plane, the program further offers the two-dimensional graphical structure of the solution and this may pave the way to comprehend the entire concepts involved in each step while using this application. If necessary, the tutor can instruct the novice students individually in the first few steps.

4. Enhancing expressions with Microsoft Word

The enhancement of mathematical expressions with the use of the three software programs ought to be demonstrated by employing particular themes. Michael (2010) wrote that Scilab features were focused on the following contents in Mathematics [22]. The result of his study indicates that while dealing with software, expressions should be taken into consideration and handled with extreme caution. For example, even if the program is supported by several math elements, mathematical contents that primarily use expressions should be concentrated in the following ways. "Application of Scilab on Numerical Calculations" works out and illustrates expressions on matrices, differential equations, double integrals, and numerical techniques with their output as specifications. Also, operations, symbols, and examples will be tabulated by the authors in their articles for better understanding [23]. These references and this article's support for using Scilab tools to address expression-related issues are evident. As a whole, a pilot implementation insists that the learners can actively interact with many of the expressions covered in Mathematics, including those linked to important contents like logic, number theory, and graph theory, according to the assisted Scilab [24]. When utilizing the Maxima program, the primary focus was on graphs or graph theory, as well as all the expressions and contents that stem from it. On reviewing the "implementation of graph theory and application by Maxima software", this Maxima software can be assisted with the expressions involved in real-life applications [25]. In the end, Microsoft Mathematics is specially designed for 2D and 3D graphics, step-by-step equation solvers [26], through expressions that can be manipulated based on deeper understanding.

The key areas and their contents will be covered in the sections that follow. In the meantime, some of the general features that the Microsoft Mathematics program supports are presented below. These features ought to be easily accessible using a template (problems as examples), and they must help students have a better understanding of how the program supports mathematical content. Some of them are pre-algebra (mean, mode, greatest common factor, least common multiple, order of operations, fractions, mixed fractions, prime factorization, exponents, and radicals), algebra (combine like terms, solve for a variable, factor, expand, evaluate fractions, linear equations, quadratic equations, inequalities, systems of equations and matrices), trigonometry (simplify, evaluate, graphs and solve equations) and calculus (derivatives, integrals and limits) [26].

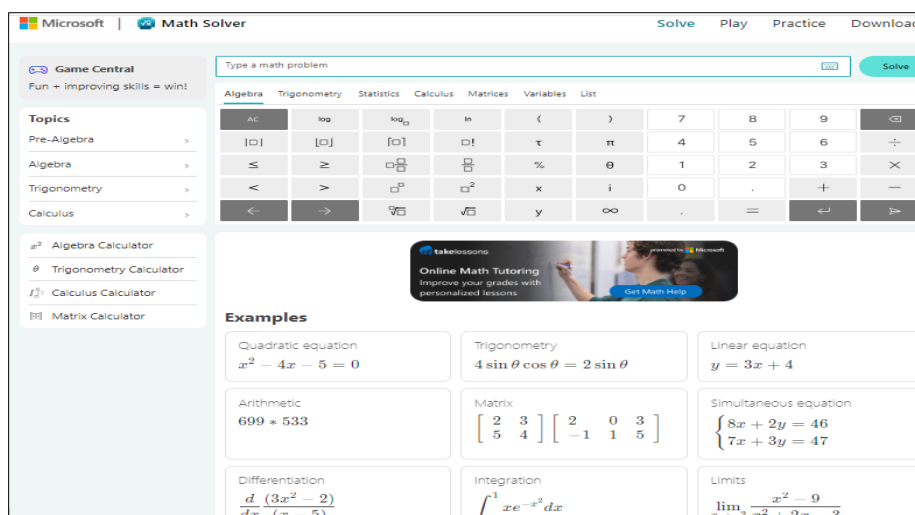


Figure 3 Representation of the Home Page of Microsoft Mathematics Software

The Microsoft Mathematics software's homepage is shown in Figure 3, which also contains a feature that lists the topics covered in mathematics along with some easily accessible templates for sample problems in areas like trigonometry, linear algebra, quadratic equations, arithmetic, matrices, simultaneous solutions, integrations, and limits—particularly those that primarily deal with different expressions [21]. It is assured that there are several resources available for students to master mathematics while employing Microsoft Mathematics in pedagogy.

4.1 Math equation

Sometimes, the teacher proposes and assists the math type assistance while handling the expressions. So, an expression consisting of variables, constants, and algebraic operations (addition, subtraction, etc.) is referred to as an algebraic expression. In mathematics, an algebraic expression consists of variables, constants, and algebraic operations (addition, subtraction, etc.). For example, some of the functions manipulated with the assistance of math type will be highlighted below.

4.2 Examples

(i) $x = 3y^2 + 4y - 7$ (ii) $y = 4x^2 - 10x - 10$ (iii) $\frac{dy}{dx} = y_1 = (3x^2 + 4x - 7)$ (iv) $\int_0^1 (2x^3 - 4x + 21) dx$

(v) $y = \log_2 x$ (vi) $A = \begin{pmatrix} 5 & 2 & 3 \\ 2 & 2 & 3 \\ 0 & 2 & 1 \end{pmatrix}$ (vii) $\frac{5}{2} [\sqrt{2x} + x]$ (viii) $\cos^{-1} 2\theta \dots$

These expressions are represented with the help of unknown variables, constants, and coefficients. The combination of these three (as terms) is said to be an expression. It is to be noted that, unlike the algebraic equation, to differentiate the algebraic expression and symbol, the specific coding in mathematics should be pictured below for better understanding.

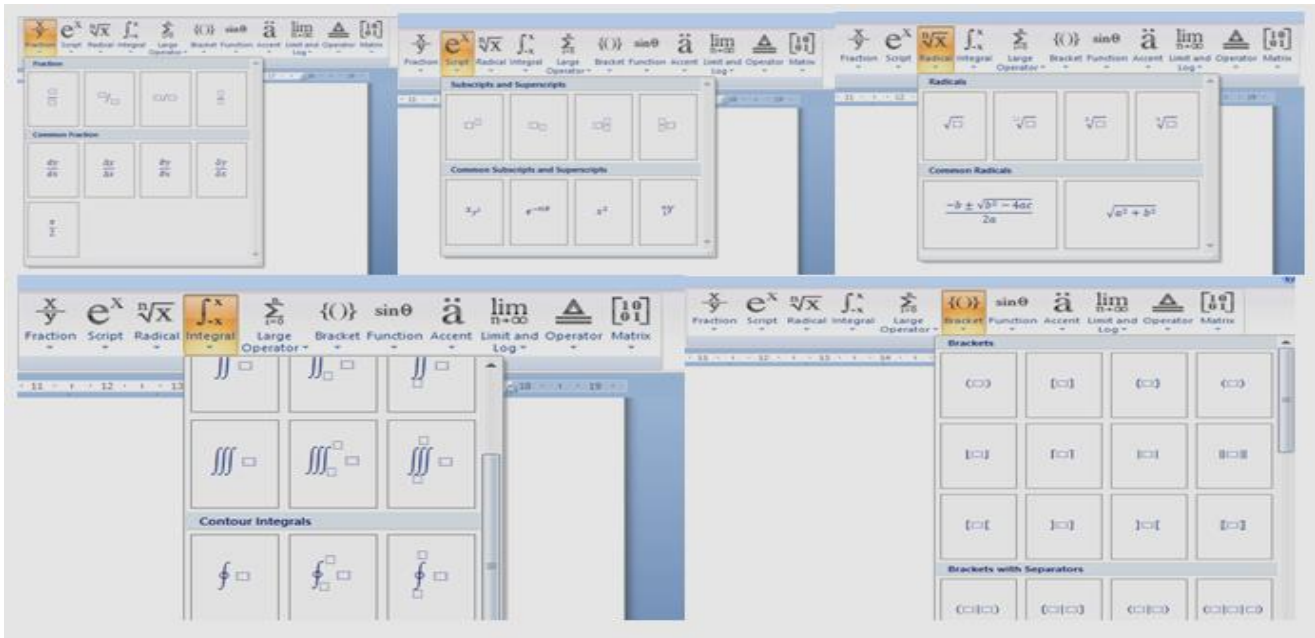


Figure 4 Pictorial representation of fraction, script, radial, integral and large operator

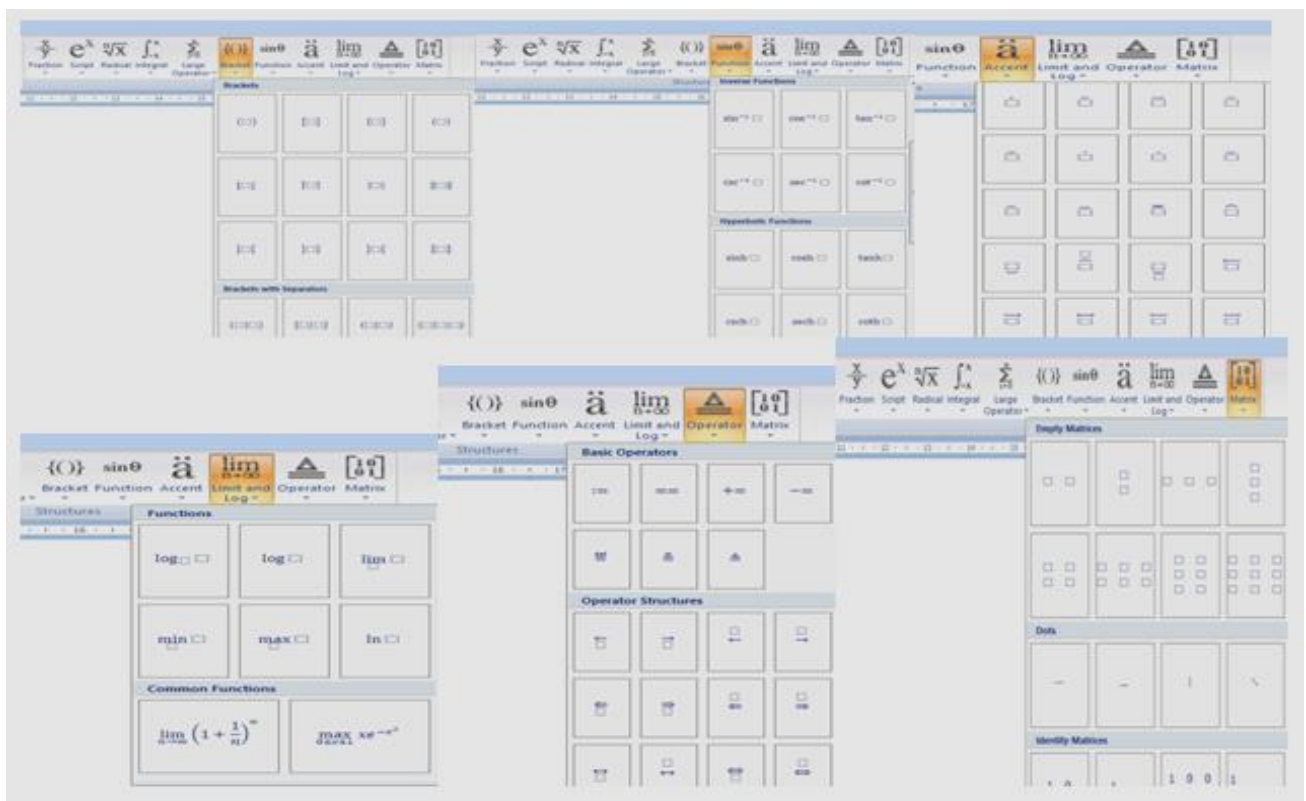


Figure 5 Pictorial representation of bracket, function, accent, limit/log, operator and matrix

5. Discussion and recommendations

The majority of the reviews done in this paper demonstrate the value of the software such as Microsoft Mathematics, SciLab, and Maxima for the systematic manipulation of mathematical expressions. Through the teachers' first use of these programs as practice, students learn about the nature of these software's and can pick particular software to practice with concerning the chosen unique material. Consequently, students can practice independently with minimal guidance from the teacher. Additionally, it makes learners' visualizations of mathematical expressions better and

increases their capacity for flexible thought. Supporting to this, a research report indicated that “it is possible to argue that the employment of diverse software can make learners more significant, who when faced with challenges, alter their perspective and make sense of the issue” [27].

As a compromise to this, even if mathematical expressions are thoroughly solved in the classroom, students still struggle with comprehension. In contrast to this, when expressions are visualized using this software, in both 2D and 3D, the learners are better able to understand the concepts symbolically. In the end, it is the instructors' responsibility to employ these sorts of pertinent software that links the mathematical subject. One of the most significant developments and applications has been the introduction of mathematical software to perform math expressions. Examples, theorem proofs, and the discovery of novel mathematical phenomena are all accomplished via mathematical software systems.

Compliance with ethical standards

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Disclosure of conflict of interest

The Authors proclaim no conflict of interest.

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