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Abstracts

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SOLVING DIFFERENTIAL EQUATIONS BY PARALLEL LAPLACE METHOD WITH ASSURED ACCURACY*

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ACM Computing Classification System (1998): I.1.
Key words: Laplace transform, parallel algorithm, systems of di_erential equations, polynomials of exponents, partial fractions, systems of linear equations.
*The paper has been presented at the 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria, June, 2006.

Abstract. We produce a parallel algorithm realizing the Laplace transform method for the symbolic solving of differential equations.
In this paper we consider systems of ordinary linear differential equations with constant coefficients, nonzero initial conditions and right-hand parts reduced to sums of exponents with polynomial coefficients.

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A RELATION BETWEEN THE WEYL GROUP W(E_8) AND EIGHT-LINE ARRANGEMENTS ON A REAL PROJECTIVE PLANE*

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ACM Computing Classification System (1998): G.2.1
Key words: Weyl group, root system of type E_8, real projective plane, simple eight-line arrangement, classification of arrangement.
*The paper has been presented at the 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria, June, 2006.

Abstract. The Weyl group W(E_8) acts on the con_guration space of systems of labelled eight lines on a real projective plane. With a system of eight lines with a certain condition, a diagram consisting of ten roots of the root system of type E_8 is associated. We have already shown the existence of a W(E_8)-equivariant map of the totality of such diagrams to the set of systems of labelled eight lines. The purpose of this paper is to report that the map is injective.

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SYMBOLIC DYNAMICS IN THE FREE-FALL EQUAL-MASS THREE-BODY PROBLEM*

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ACM Computing Classification System (1998): J.2.
Key words: Three-body problem, symbolic dynamics.
*The paper has been presented at the 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria, June, 2006.

Abstract. Free-fall equal-mass three-body systems are numerically studied using symbolic dynamics. We scan the two-dimensional homology map of initial configurations in steps of 0.001 along both axes. States of binary and triple encounters as well as changes of configuration are used to construct symbolic sequences. Symbolic sequences are characterized by Shannon and Markov entropies. Different ergodic components corresponding to different distinct peaks on the histograms of these entropies are revealed.

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OPTIMIZATION OF RATIONAL APPROXIMATIONS BY CONTINUED FRACTIONS*

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ACM Computing Classification System (1998): G.1, G.1.1, G.1.2, G.1.10, G.4.
Key words: C-XSC, continued fractions, error bounds, Special Functions.
*The paper has been presented at the 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria, June, 2006.

Abstract. To get guaranteed machine enclosures of a special function f(x), an upper bound ε(f) of the relative error is needed, where ε(f) itself depends on the error bounds ε(app); ε(eval) of the approximation and evaluation error respectively. The approximation function g(x) ≈ f(x) is a rational function (Remez algorithm), and with sufficiently polynomial degrees ε(app) becomes sufficiently small. Evaluating g(x) on the machine produces a rather great ε(eval) because of the division of the two erroneous polynomials. However, ε(eval) can distinctly be decreased, if the rational function g(x) is substituted by an appropriate continued fraction c(x) which in general needs lees elementary operations than the original rational function g(x). Numerical examples will illustrate this advantage.

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ALGEBRAIC COMPUTATIONS WITH HAUSDORFF CONTINUOUS FUNCTIONS*

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ACM Computing Classification System (1998): I.1.2
Key words: Hausdor_ continuous function, ultra-arithmetical functoid.
*The paper has been presented at the 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria, June, 2006.

Abstract. The set of Hausdorff continuous functions is the largest set of interval valued functions to which the ring structure of the set of continuous real functions can be extended. The paper deals with the automation of the algebraic operations for Hausdorff continuous functions using an ultra- arithmetical approach.

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COMPUTING AND VISUALIZING SOLUTION SETS OF INTERVAL LINEAR SYSTEMS*

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ACM Computing Classification System (1998):G.1, G.1.3, G.4.
Key words: solution sets, interval linear systems, reliable computations, visualization using computer algebra tools, intpakX.
*The paper has been presented at the 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria, June, 2006.

Abstract. The computation of the exact solution set of an interval linear system is a nontrivial task [2, 13]. Even in two and three dimensions a lot of work has to be done. We demonstrate two different realizations. The first approach (see [16]) is based on Java, Java3D, and the BigRational package [21]. An applet allows modi_cations of the matrix coefficients and/or the coefficients of the right hand side with concurrent real time visualization of the corresponding solution sets. The second approach (see [5]) uses Maple and intpakX [22, 8, 12] to implement routines for the computation and visualization of two and three dimensional solution sets. The regularity of the interval matrix A is verified by showing that $\rho(|I - mid^{-1}(A) * A|) < 1$ [14]. Here, I means the identity matrix, mid(A) denotes the midpoint matrix and denotes the spectral radius of a real matrix.

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INTRODUCTION TO THE MAPLE POWER TOOL intpakX*

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ACM Computing Classification System (1998): G.1.0, G.1.5, G.4.
Key words: Computer Algebra, Validated Computations, Visualization of Interval Methods, Didactical Tool, Maple Power Tool, intpakX.
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Abstract. The Maple Power Tool intpakX [24] defines Maple types for real intervals and complex disc intervals. On the level of basic operations, intpakX includes the four basic arithmetic operators, including extended interval division as an extra function. Furthermore, there are power, square, square root, logarithm and exponential functions, a set of standard functions, union, and intersection. Reimplementations of the Maple construction, conversion, and unapplication functions are available. Additionally, there is a range of operators for complex disc arithmetic.

As applications, verified computation of zeroes (Interval Newton Method) with the possibility to find all zeroes of a function on a specified interval, and range enclosure for real-valued functions of one or two variables are implemented, the latter using either interval evaluation or evaluation via the mean value form and adaptive subdivision of intervals. The user can choose between a non-graphical and a graphical version of the above algorithms displaying the resulting intervals of each iteration step. The source code (about 2000 lines of Maple{code) of the extension intpakX is freely available [23].

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A COMPUTER ALGEBRA APPLICATION TO DETERMINATION OF LIE SYMMETRIES OF PARTIAL DIFFERENTIAL EQUATIONS*

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ACM Computing Classification System (1998): G.4, I.1.2, I.1.4, J.2.
Key words: MATHEMATICA package, Lie symmetries, partial differential equations.
*The paper has been presented at the 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria, June, 2006.

Abstract. A MATHEMATICA package for finding Lie symmetries of partial di_erential equations is presented. The package is designed to create and solve the associated determining system of equations, the full set of solutions of which generates the widest permissible local Lie group of point symmetry transformations. Examples illustrating the functionality of the package's tools are given. The results of the package application to performing a full Lie group analysis of coupled nonlinear Schrödinger equations from nonlinear fiber optics are presented. Comparisons with earlier published computer algebra implementations of the Lie group method are discussed.