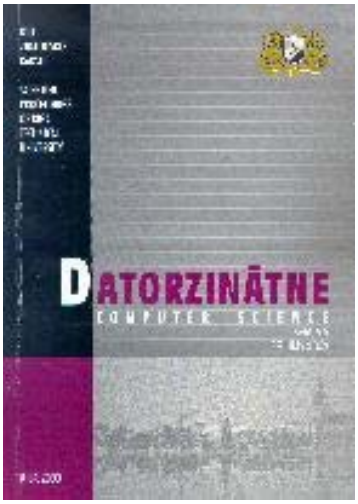

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Nguyen-Ba T., Bozic V., Kengne E., Vaillancourt R. One-step 4-stage Hermite–Birkhoff–Taylor ODE Solver of order 14

A one-step 4-stage Hermite–Birkhoff–Taylor method of order 14, denoted by HBT(14)4, is constructed for solving nonstiff systems of first-order differential equations of the form $y' = f(x, y)$, $y(x_0) = y_0$. The method uses derivatives y' to $y^{(11)}$ as in Taylor methods combined with a 4-stage Runge–Kutta method. Forcing a Taylor expansion of the numerical solution to agree with an expansion of the true solution leads to Taylor- and Runge–Kutta-type order conditions which are reorganized into Vandermonde-type linear systems whose solutions are the coefficients of the method. The new method has larger scaled interval of absolute stability than

Dormand–Prince DP(8,7)13M and 4-stage Hermite–Birkhoff–Obrechkoff method of order 14. The stepsize of this method is controlled by a formula which uses two high-order derivatives. HBT(14)4 is superior to DP(8,7)13M and Taylor method of order 14 in solving several problems often used to test higher-order ODE solvers on the basis the number of steps, CPU time, and maximum global error. These numerical results show the benefits of adding high-order derivatives to Runge–Kutta methods. (pp.26-41)

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G.Burov. Computer modeling of conditions of analog technical objects

In this work the problem of application of computer methods for the control of operational conditions of analog dynamic technical objects is examined. For this purpose it is offered to use the parametrical control over the generalized characteristics of the discrete operator, in which the analog transfer function is mapped. It allows to compensate in the operational way the influence of errors of discrete approximation on the accuracy of the parametrical control. Functional transformations for recalculation of the field of admissions on parameters of analog transfer function into the discrete form are developed. Expressions for systems of equations are derived, in which the influence of the sampling period of signal values is directly visible. Identification of extreme conditions of the object related to structural failures is offered to make using operator methods. (pp.65-76)

G. Burov. Models for decoding the results of computer control of analog technical objects

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M.Iltina, I.Iltins. Generalized Taylor series and its application for calculating convolution

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Mul O. V., Kravchenko V. P., Kravchenko O. V., Sidi Ammi M. R. Analysis of stability and controllability of thermophysical fields in foundry industry

In this paper it is formulated the problem of a control vector construction for the process of controlled cooling of a structurally heterogeneous technical system. The process of cooling is considered as a nonstationary one. The considered problem is reduced to the continuous-discrete boundary problem for systems of differential equations of the first order in the normal form. The use of the properties of supporting hyperplanes allows obtaining the expression for the vector of the cooling process control. The values of normal fundamental functions for solutions of the system of differential equations are used for the numerical determination of the mentioned vector. (pp.94-101)

Spalviņs A., Slangens J., Lace I., Janbickis R., Skibelis V., Eglite I. Modelling of local contamination migration for the Zakumuiza well field

The regional hydrogeological model (HM) has been created for the Baltezers, Rembergi and Zakumuiza water supply complex that provides the Riga city with drinking water. By using the telescopic mesh refinement procedure (TMR), included in the Groundwater Vistas (version 4) system, local HM can be created for any area chosen within regional HM. The TMR procedure was applied, to create local HM for the northern part of the Zakumuiza well field that is a siphon type system. It is endangered by possible spills of hazardous substances, as a result of road accidents on the nearby highway. The MODPATH system was used to obtain information of

contaminant migration time and its main path, along which the kernel of contaminant plume should migrate. On the path, concentration monitoring wells were inserted. For the final stage of modelling, the MT3D system was applied, to obtain variable concentration distributions versus time. The results of modelling confirmed that the contaminant migration time was large enough (~1200 days), to protect the siphon from intrusion of contaminants. (pp.102-107)

Spalvins A., Slangens J. Impact of boundary conditions on quality of hydrogeological models

Boundary conditions of the first and second types (fixed heads and flows) have quite different effect on quality of results provided by hydrogeological models (HM). It is shown in this paper that one should prefer use of the first type conditions on the external borders of HM, because: accuracy of the head distribution on the border is better than for the flows; HM is not so sensitive against possible errors of its parametres, especially, in the HM external border area; the solver program works mach faster. Even nowadays, modellers often apply external no-flow boundaries for HM, because no data are needed to support them. Results of test problems, considered in the paper, show that neglectful use of the no-flow boundaries may lead to dramatic loss of the HM accuracy. For large regional HM, the ground surface elevation map must be used as the fixed head condition, in order to obtain right infiltration distributions on the HM top, instead of the commonly used fixed inaccurate infiltration flow as the second type boundary condition. (pp.108-117)

Spalvins A., Slangens J., Krauklis K. Updating of geological data interpolation programs

In the publication, the role of software tools GDI, KRP, GRD is explained. They have been developed by the Environment Modelling Centre of RTU. These tools are special programs that prepare 2D – digital parametre maps for creating spatial models. The tools are compatible with licensed software used for running these models. The tools had been updated regularly, since 1990. In 2007, the latest version of the tools has been obtained. The original programs used DOS

Fortran 77 environment that was not fully compatible with the modern software tools. To overcame this drawback, the standard of Fortran 90 was introduced, the module of visualization for input and output data was developed and compatibility with the WINDOWS XP system ensured. Due to the recent update, the programs for models can prepare the 2D-grid maps of order $N \geq O(106)$. (pp.118-129)

Spalviņs A., Slangens J. Improved method for controlling the geological data interpolation program

The geological data interpolation program (GDI) is applied for preparing digital maps, as the input for creating hydrogeological models. The GDI program has been updated recently. During this process, the new method has been developed for transformation of the GDI interpolation matrix. Algorithms used by the old and new methods are considered. The new method allows to apply two parameters, instead of the single old one, for controlling the transformation. The method replaces the factorial function, applied by the old method by the gamma function that can use positive rational numbers, as the first control parameter. The second parameter gives the radius of the transformed grid area. Due to these improvements, the shape of surfaces, representing interpolation results, can be controlled more effectively. Examples are provided that illustrate results obtained by using the improved method. (pp.130-136)

Cernajeva S., Eglite I. Organization of mathematical education process in the Riga Technical University

Organization of process of mathematical education in universities can be examined in two directions - creation of the study programs and organization of the teaching process. Based on the results of students` inquiries in the Riga Technical University, and on observations by lecturers of the department of engineering mathematics, three following factors determining the organization of teaching process are analyzed in the article: previous preparedness of students; study style; age specifics. First two factors are particularly topical for the full time students who perceive studies as a daily process. Also the specific features of adult education that is

characteristic for part time and master study program students are examined in the article. (pp.137-145)