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“MMSC’2001”: Mathematical Modelling and Scientific Computations

S. Markov, M. Krastanov

Report on International Meeting

Report on a Minisymposium within the 30-th Spring Conference of the Union of the Mathematicians in Bulgaria (UBM), April 10, 2001, Borovets.

Organized by: S. Markov, M. Krastanov

Supported by: Section “Biomathematics and Scientific Computations” of the Union of Bulgarian Mathematicians and the Bulgarian Section of the Gesellschaft für Angewandte Mathematik und Mechanik (GAMM-BG).

The 30-th Spring Conference of the Union of the Mathematicians in Bulgaria (UBM) took place in the Hotel “Samokov” of Borovets, Bulgaria, from the 8-th to 11-th April 2001. Many diverse scientific areas in mathematics, mechanics, informatics and mathematical education were represented at the Conference. Various discussions have been also included on educational problems, professional training, etc. The 30-th UMB Spring Conference was attended by 550 participants and contributed to strengthening the contacts between secondary school teachers and university professors and specialists.

The Proceedings of the Spring Conferences are published in the series “*Mathematics and Education in Mathematics*” and are reviewed by Mathematical Reviews and Zentralblatt für Mathematik. Following the established tradition, the Proceedings of the 30-th Spring Conference appeared prior to the meeting, [?].

The Minisymposium **Mathematical Modelling and Scientific Computations** took place on the 10-th of April 2001. The minisymposium was organised with the support of the recently organized Section “Biomathematics and Scientific Computations” at the Union of Bulgarian Mathematicians

and the Bulgarian Section of the Gesellschaft für Angewandte Mathematik und Mechanik (GAMM-BG) and followed the traditions of the MMSC'93 and the BIOMATH-95 conferences. The aim of the minisymposium was to bring together specialists from diverse areas of mathematics and computer science and specialists in applications in biology and engineering. The presented papers describe new modelling methodologies and feature novel applications.

The minisymposium comprised the following seven presentations, cf. [?], pp. 432-467:

1. A. Alexandrov: A mathematical model of tubulin pulse generator

Gonadotropin-releasing hormone (GnRH) plays an integrating role between the neural and endocrine systems. GnRH is the central peptide hormone regulating the synthesis and release of the gonadotropins luteinizing hormone (LH) and follicle - stimulating hormone (FSH). In the past few years patterns of high frequency oscillations (high frequency pulses) with a period of 1 to 3 min in the secretion of LH and FSH were observed. The mechanism causing the oscillations of the LH and FSH response in gonadotrophs is still unknown. This article focuses on the hypothesis that the tubulin polymerization and depolymerization is a generator for the high frequency oscillations in the pituitary cells.

2. C. Christov and N. Papanicolaou: Galerkin spectral methods for higher-order boundary value problems arising in fluid mechanics

We develop Galerkin spectral technique for solving boundary value problems arising in natural convection. They consist of a fourth-order b.v.p. for the stream function coupled to a second-order b.v.p. for the temperature. As a basis are used the set of so-called Beam functions introduced by Lord Rayleigh and the set of Fourier functions. The formulas for the cross expansions between the two sets are derived and a Galerkin spectral algorithm is created. A featuring example is solved and the issues of the rate of convergence and truncation error are clarified.

3. F. Jezequel: Numerical accuracy of converging sequences

If we compute a sequence having a linear convergence until the difference between two successive iterates is not significant, the result obtained has the best numerical accuracy for the computer used. Furthermore its exact significant digits are those of the mathematical value of the limit, up to one bit. This strategy can be used for the trapezoidal or Simpson's method, a sequence is then generated by halving the step value at each iteration.

For Romberg’s method, which consists in computing a sequence having a super-linear convergence, a similar strategy can also be used.

4. Nedialko S. Nedialkov and Kenneth R. Jackson: Some recent advances in validated methods for IVP’s for ODE’s

The paper presents an overview of interval Taylor series (ITS) methods for IVPs for ODEs and discuss some recent advances in the theory of validated methods for IVPs for ODEs, such as, an interval Hermite-Obreschkoff (IHO) scheme, the stability of ITS and IHO methods, and a new perspective on the wrapping effect.

5. E. Neuwirth: Visualizing recursion and difference equations using spreadsheets

This lecture provides demonstrations about the use of spreadsheets for the visualization of recursion relations and difference equations. More about this topic can be found at:

<http://sunsite.univie.ac.at/Spreadsite/>

6. A. Popov: On some imprecise geometrical computations based on morphological techniques

This work studies some problems arising in image processing, computational geometry and robot guidance due to uncertainty and imprecision in the environmental model and the input data. More precisely, based on so-called Epsilon-geometry approach combined with morphological techniques we find ε -connected components of a given object and analyse the opportunities for approximations of the skeleton of the object.

7. S. Yanchuk and T. Kapitaniak: Modelling chaos-hyperchaos transition in coupled Rössler systems

Many of the nonlinear high-dimensional systems have hyperchaotic attractors. Typical trajectory on such attractors is characterized by at least two positive Lyapunov exponents. The authors provide numerical evidence that chaos-hyperchaos transition in continuous systems can be characterized by the set of infinite number of unstable periodic orbits embedded in the attractor as it was previously shown for the case of coupled discrete maps.

Acknowledgements. The Organizers of the Minisymposium wish to thank the Organizers of the 30-th Spring Conference for including the Minisymposium in the scientific program of the conference and their cooperation.

References

- [1] In: *Mathematics and Education in Mathematics*, Union of Bulgarian Mathematicians, Proc. 30-th Spring Conference of UMB, Borovets, April 8-11, 2001, 432-467.

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