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TEACHING

1. Analysis

Lectures notes for second-year students of the Faculty of Electricity, Electronics and Automatics

1. Laplace transform and applications to ODEs and PDEs.
2. Complex analysis
3. Basic numerical methods
4. Probability and statistics

The exhibition is very closed to the content and character of mathematics in the books:

1. E: Kreyszig, Advanced engineering mathematics, seventh edition, 1993, John Wiley and Sons, Inc.
2. J.L.Shiff, The Laplace transform, (1991), Springer

2. Numerical Methods

a) Lectures notes for third-year students of Mathematics and Informatics. Faculty of Science and Education

b) Lecture Notes:

The Finite Element Method 1. Stationary Problems. 2. Evolution Problems (In Bulgarian)

3. Theory of probability and statistics

Lectures for third-year students of speciality Mathematics and Informatics, Faculty of Science and Education: Theory and applications of probability and statistics (in Bulgarian)

Lecture Notes for master and PhD students:

1. The maximum principle in the theory of difference scheme (2008) (with M. Koleva)
2. Immersed interface method (2009) (with J. Kandilarov)
3. Numerical methods for singularly perturbed problems (2010) (with I. Angelova)

Research interests:

1. Numerical methods for PDEs: problems with interfaces and boundary layers.
2. Analytical analysis of PDEs problems with interfaces and boundary layers
3. Numerical methods in mathematical finance

- I am a member of the Editorial Board of the international journals:
International Journal of Numerical Analysis and Modeling (IJNAM);

Natalia Kopteva, Eugene O'Riordan and I jointly guest-edited the special issue "Computational Methods for Boundary and Interior Layers" of IJNAM that was produced in 2010 (vol.7, No3) to mark the occasion of Professor G.I. Shishkin 70-th Birthday.

- I am leader of the Current Project: **Robust numerical methods for problems with interface and interior boundary layers**, IDEI, 2010-2013, ID-09-0186, NSF (Bulgarien National Science Fund)
- I am person in charge of scientific and technical/technological aspects in the project: **304617 STRIKE-Novel Methods in Computational Finance, FP7-PEOPLE-2012-INT, Marie Curie**

Actions-Initial Training Networks (INT), Multi-partner ITNs (ITN)

PUBLICATIONS (1999 -)

Journal publications:

1. L.G. Vulkov, Conservation laws and symmetrization of the equations of incompressible inviscid fluids, *Quart. of Appl. Math.*, 57, N 3 (1999), pp. 549-560
2. I. A. Braianov and L.G. Vulkov, Grid approximation for the solution of the singularly perturbed heat equation with concentrated capacity, *J. of Math. Anal. Appls*, v.237, 672-697 (1999)
3. Braianov, I.A.; Vulkov L.G.: Homogeneous difference schemes for the heat equation with concentrated capacity. *Comp. Math. Math. Phys.* , 39 (1999), 254-261
4. Braianov, I.; Vulkov, L.: Uniform in a small parameter convergence of Samarskii's monotone scheme and its modification for the convection-diffusion equation with concentrated source, *Comp. Math. and Math. Phys.*, v.40, N4, (2000), pp. 534-550
5. L.G.Vulkov, J.D. Kandilarov, Construction and implementation of finite- difference schemes for systems of diffusion equations with localized chemical reactions, *Comp. Math. and Math. Phys.*, V 40, N5, 2000, 705-717
6. L.G. Vulkov, On the conservation laws in magnetohydrodynamics, *Applicable Analysis. Vol. 75(1-2)*, (2000), pp. 1-18
7. Jovanovic, B.; Vulkov, L.: On the convergence of finite difference schemes for the heat equation with concentrated capacity. *Numerische Mathematik*, vol.89, N.4 (2001), pp. 715-734
8. B.S. Jovanovic and L. G. Vulkov, On the convergence of difference schemes for hyperbolic problems with concentrated data, *SIAM J. Numer. Anal.*, 41, N 2, (2003),516-538
9. B.S. Jovanovic, L.G. Vulkov, On the rate of convergence of difference schemes for the Poisson equation with dynamical interface condition, *Comp. Meth. in Appl. Math.*, 3, N 1, (2003)
10. J.D.Kandilarov, L.G.Vulkov, Analysis of immersed interface difference schemes for reaction-diffusion problems with singular own sources, *Comp. Meth. In Appl. Math.* 3, N 2, (2003)
11. I.A.Braianov, L.G.Vulkov, Numerical solution of reaction-diffusion elliptic interface problem with strong anisotropy, *Computing*, 71, N 2, (2003), 153-173
12. J.D. Kandilarov, L.G.Vulkov, The immersed interface method for a nonlinear chemical diffusion equation with local sites of reactions, *Numerical Algorithms*, v. 36, N4, (2004), 285-307
13. I.Tr.Angelova, L.G.Vulkov, Singularly perturbed differential equations with discontinuous coefficients and concentrated factors, *Appl. Math. and Comput.*, v.158, (2004), 683-701
14. B.S. Jovanovic, L.G. Vulkov, Stability of difference scheme for parabolic equations with dynamical boundary and conjugation conditions, *Appl. Math. and Comput.*, v.163, (2005), 849-868
15. L.G. Vulkov, B.S. Jovanovic, Convergence of difference schemes for Poisson equations with dynamical boundary conditions, *Comp. Math. and Math. Phys.* v 45, N2 (2005), 287-297
16. B.S. Jovanovic, L.G. Vulkov, Energy stability for a class of parabolic interface problems, *J. of Math. Anal. Appl.*, v.311 (2005), 120-138
17. M.N. Koleva, L.G.Vulkov, On the blow-up of finite difference solutions to the heat-difusion equation with semilinear dynamical boundary conditions *Appl. Math. and Comput* , v.161, (2005)
18. I.Tr.Angelova, L.G.Vulkov, High-order difference schemes for one-dimensional interface problems based on new Marchuk integral identities, *J. Numer. Math.* V.13, N1, (2005), 824-843
19. M. Koleva, L.Vulkov, Blow-up of continuous and semidiscrete solutions to elliptic equations with semilinear dynamical boundary conditions of parabolic type, *J. Comp. Appl. Math.*, v. 202, N2 (2007)
20. M. Koleva, L.Vulkov, Numerical solution of the heat equation with nonlinear boundary condition in unbounded domains, *Numer. Methods for PDEs* , v. 23, N2 (2007)
21. J.D.Kandilarov, L.G.Vulkov, The immersed interface method for two-dimensional heat-diffusion equations with singular own sources, *Appl. Numer. Math.* v.57 (5-7) (2007)
22. I. Angelova, L. Vulkov, High-order difference schemes for elliptic problems with intersecting interfaces, *Appl. Math. And Comp.*, 187 (2007) 824-843
23. I. Angelova, L. Vulkov, Marchuk identity-type second order difference schemes of 2-D and 3-D elliptic problems with intersected interfaces, *Krag. J. Math.*, 30 (2007) 277-292
24. B.S. Jovanovic, L.G. Vulkov, On the convergence of difference scheme for parabolic problems with concentrated data, *Int. J. Numer. Anal. and Modeling*, v.5, N3, (2008), 386-407
25. . L.G.Vulkov, Blow-up of some quasilinear equations with dynamical boundary conditions, *Appl. Math. Comp.*, v.191 (2007)
26. B.S. Jovanovic, L.G. Vulkov, Finite difference approximations of strong solutions of a parabolic interface problem on disconnected domains, *Publ. Inst. Math.* 84 (98)(2008), 37-48

27. B.S.Jovanovic, L.G.Vulkov, Finite difference approximations for some interface problems with variable coefficients *Appl. Numer. Math.* 59 (2009), 349-372
28. B.S. Jovanovic, L.G. Vulkov, Formulation and analysis of parabolic interface problems on disjoint intervals (submitted)
29. B.S. Jovanovic, L.G. Vulkov, Numerical solution of a parabolic transmission problem, *IMA J. Numer. Anal.* (2009) (accepted) doi=10:1093 / imanum / drn 077,
30. L.G.Vulkov, A.I.Zadorin, Two-grid algorithms for an ordinary second order equation with an exponentially boundary layers *IJNAM* v.7, N3 (2010), 580-593,
31. B.S. Jovanovic, L.G. Vulkov, Numerical solution of a two-dimensional transmission parabolic problem *IJNAM*, v.7, N1 (2010), 156-173
32. M.N. Koleva, L.G. Vulkov, Two-grid quasilinearization approach to ODEs with applications in model problems of physics and mechanics *Computer Physics Commn.* 181(3), 663-670 (2010)
33. B.S. Jovanovic, L.G.Vulkov, Numerical solution of a two-dimensional hyperbolic problem, *J. Comp. Appl. Math., J. Comp. Appl. Math.* 235 (2010), 519-534
34. B. Jovanovic, M. Koleva, L. Vulkov, Convergence of a FEM and Two-Grid Algorithms for Elliptic Problems on Disjoint Domains, *Journal of Computational and Applied Mathematics*, V. 236, N 3 (2011) 364 – 374.
35. B. S. Jovanovic, L. G. Vulkov: Numerical solution of a parabolic transmission problem. *IMA J. Numer. Anal.* 31 (2011), 233–253 (MR2755944, Zbl 1215.65140).
36. I. Tr. Angelova, L.G. Vulkov, A two-grid method for singularly perturbed reaction-diffusion problems on layer adapted meshes (submitted)
37. B.S. Jovanovic and L.G. Vulkov, Analysis of semidiscrete approximations of blow up weak solutions to semilinear parabolic equations, (submitted)
38. B.S. Jovanovic and L.G. Vulkov, Richardson extrapolation in spectral problems with eigenvalues in boundary and conjugation conditions (submitted)
39. J. D. Kandilarov, L.G.Vulkov, Construction and analysis of immersed interface difference schemes for reaction-diffusion equations with moving own concentrated sources (submitted)
40. B.S. Jovanovic and L.G. Vulkov, Regularity of solutions and a priori estimates for elliptic interface problems (submitted)
41. M. N. Koleva, L.G. Vulkov, Quazilinearization numerical scheme for fully nonlinear parabolic problems with applications in models of mathematical finance (submitted)
42. M. Koleva, L. Vulkov, Quazilinearization numerical scheme for fully nonlinear parabolic problems with applications in models of mathematical finance, *Mathematical and Computer Modelling*, ELSEVIER, under review.
43. M.K. Kolev, M. N. Koleva, L. Vulkov, Two positivity preserving flux limited, second-order numerical methods for a Haptotaxis model, submitted in *Numerical Methods for PDE*
44. M.K. Kolev, M. N. Koleva, L. Vulkov, An unconditionally positivity preserving difference scheme for models of cancer migration and invasion, submitted in *Appl. Math. Modelling*

Refereed Conference publications:

1. L.G. Vulkov, An ADI Method for Singularly Perturbed Nonstationary Problems with Curvilinear Boundary or Interface, pp.96-98 *Appls of Math. in Engeneering and Economics*, Proceed. of the XXV Summer School, Sozopol'99 Eds. B.I. Cheshankov, M.D. Todorov, Heron Press, Sofia, (2000)
2. I.A. Braianov, L.G. Vulkov, Uniformly convergent difference scheme for the singularly perturbed convection-diffusion parabolic problem with concentrated capacity, *NOVA Science Publishers, Inc., New York*, (2000), 1-169
3. I.A. Braianov, J.D. Kandilarov, L.G. Vulkov, Numerical solution of diffusion-desorbtion problems with small diffusion coefficients and localized chemical reactions, *Analytical and Numerical Methods for Convection-Dominated and Singularly Perturbed Problems*, NOVA Science Publishers, Inc., New York, (2000), pp. 161-169
4. B.S.Jovanovic, L.G. Vulkov, On the convergence of difference scheme for the string equation with concentrated mass. *FDS-2000 Conference*, pp. 107-116. B. Ciegis et al. (Eds).
5. J.D. Kandilarov, L.G.Vulkov, A.I. Zadorin, A method of lines approach to the numerical solution of singularly perturbed elliptic problems, *Lect. Notes in Comp. Sci* , v 1988, (2001),

pp. 451-459

6. Jovanovic, B.S.; Vulkov, L.G. Operator's approach to the problems with concentrated factors. *Lect. Notes in Comput. Sci.*, v. 1988, (2001), pp. 439-451
7. Jovanovic, B.S.; Kandilarov, J.D.; Vulkov, L.G.: Construction and convergence of difference scheme for a model elliptic equation with Dirac--delta function coefficient. *Lect. Notes Comput. Sci.*, v. 1988, (2001), pp. 431-439
8. B. Jovanovic, L. Vulkov, Stability and convergence of difference schemes for parabolic interface problems, *FILOMAT*, v.15 (2002), pp.235-244
9. I.Tr. Dimitrova, L.G. Vulkov, On the numerical solution of singularly perturbed interface problems, pp.249-257, *Appls of Math. in Engeneering and Economics, Proceed. of the XXV Summer School, Sozopol'99* Eds. D. Ivanchev, M.D. Todorov, Heron Press, Sofia, (2002)
10. I.Tr. Dimitrova, L.G. Vulkov, High order uniform methods for singularly perturbed reaction-diffusion problems with discontinuous coefficients and singular sources, *FILOMAT*, v.15 (2002)
11. I.A. Braianov, L.G. Vulkov, Uniformly convergent finite-volume difference scheme for singularly perturbed convection-diffusion interface problems, *Lect. Notes Comput. Sci* (2003)
12. B.S.Jovanovic, L.G.Vulkov, Finite difference approximations of an elliptic interface problem with variable coefficients, *Lect. Notes in Comp.Sci.* v.3401 (2005)
13. I. Angelova, L. Vulkov, Uniformly convergent of finite-difference schemes for a reaction-diffusion interface problems, *Lect. Notes Comp. Sci.*, v. 4818 (2007)
14. J. Kandilarov, M. Koleva and L. Vulkov, A second-order Cartesian grid finite volume technique for elliptic interface problems, *Lect. Notes Comp. Sci*, v.4818 (2007), 679-687
15. L.G. Vulkov, Well posedness and a monotone iterative method for a nonlinear interface problem on disjoint intervals, *Amer. Inst. Of Physics, Proceedings Series 946* (2007)
16. M. Koleva, L.Vulkov, Blow-Up of Finite Difference Solutions to Parabolic Equations with Semilinear Dynamical Boundary Conditions, *Proceedings of Fourth International Conference "Finite Difference Methods: Theory and Applications, I. Farago, P. Vabishchevich and L. Vulkov (Eds), 2007, 239-245*
17. M. Koleva, L. G. Vulkov, Blow-up of finite difference solutions to parabolic equations with semilinear dynamical boundary conditions, *Proceedings of Fourth International Conference "Finite Difference Methods: Theory and Applications, I. Farago, P. Vabishchevich and L. Vulkov (Eds), 2007, 239-245*
18. L.Vulkov, A. Zadorin, Two-grid interpolation algorithms for difference schemes of exponential type for semilinear diffusion convection-dominated equations, *Amer. Inst. Of Phys. CP series 1067, (2008) 284-292*
19. I. Tr. Angelova, L. Vulkov, Comparison of the two-grid method on different meshes for singularly perturbed semilinear problem. *Amer. Inst. Of Phys. CP series 1067 (2008), 305-312*
20. B. Jovanovic, J. Kandilarov and L.Vulkov, Increasing of the accuracy in the computation of the concentrations in diffusion models with localized chemical reactions, *Amer. Inst.of Phys. CP series 1067 (2008), 259-261*
21. B. Jovanovic, L. Vulkov, Finite element approximation of an elliptic boundary value problem with interface LNCS, v. 5434, Springer, (2009)
22. L.G. Vulkov and A.I.Zadorin, A two-grid algorithm for solution of the difference equations of a system of singularly perturbed semilinear equations, LNCS, v. 5434, Springer, (2009)
23. M. N. Koleva, L. G. Vulkov, A fast numerical method for a nonlinear Black-Sholes equation, *American Institute of Physics CP 1184 (2009) 64-71*
24. M. N. Koleva, L. G. Vulkov, Two-grid decoupling method for elliptic problems on disjoint domains, *Lect. Notes in Comp. Sci.* 5910 (2010) 787-795

25. I.Tr. Angelova, L. G. Vulkov, A two-grid method on layer-adapted meshes for semilinear 2D reaction-diffusion problem, LNCS, 5910 (2010) 703-710
26. M. Koleva, L. Vulkov, A Kernel-Based Algorithm for Numerical Solution of Nonlinear PDEs in Finance, Lect. Notes in Comp. Sci, SPRINGER, Lect. Notes in Comp. Sci. 7116 (2012) 566-573.
27. M. Kolev, M. Koleva, L. Vulkov, Positive preserving numerical methods for haptotaxis models, Proceedings of the Sixth Annual Meeting of the Bulgarian Section of SIAM (2012) 68-73, ISSN: 1313-3357.
28. N. Ishimura, M. Koleva, L. Vulkov, Numerical solution of nonlinear evolution equation for the risk preference, Lect. Notes in Comp. Sci 6046 (2011), SPRINGER, 445 - 452.
29. M. Koleva, L. Vulkov, A numerical study of a parabolic Monge-Ampère equation in mathematical finance, Lect. Notes in Comp. Sci 6046 (2011), SPRINGER, 461 - 468.
30. N. Ishimura, M. Koleva, L. Vulkov, Numerical solution via transformation methods of nonlinear models in option pricing, American Institute of Physics CP 1301 (2010) 387- 394.
31. M. Koleva, R. Valkov, Numerical solution of one-phase Stefan problem for a non-classical heat equation, American Institute of Physics CP 1293 (2010) 39-46.

Conference Proceedings Books:

1. A. Samarski, P. Vabishchevich, L. G. Vulkov (Eds) Finite Difference Methods: Theory and Applications, Nova Science, U.S.A., (1999)
2. L.G. Vulkov, J.J.H.Miller and G.I. Shishkin (Eds.), Analytical and Numerical Methods for Convection-Dominated and Singularly Perturbed Problems, Nova Science Publishers, New York, 2000.
3. L.Vulkov, J. Wasniewski, P. Yalamov (Eds), Numerical Analysis and Its Applications, Lect. Notes in Comp. Sci.,v. 1988 Springer, (2001)
4. Z.Li, L. Vulkov and J.Wasniewski (Eds), Numerical Analysis and its Applications, Lecture Notes on Computer Sci. v 3401, Springer, 2005
5. I. Farago, P. Vabishchevich and L. Vulkov (Editors), Finite Difference Methods: Theory and Applications, Proceedings of Fourth International Conference FDM: T & A'06, August 26-29, 2006, Rousse University (2007)
6. S. Margenov, L.G. Vulkov, J. Washniewski (Eds), Numerical Analysis and Its Applications, Lect. Notes in Computer Science, v 5434, Springer, 2009

Doctoral Degree Students:

1. I.N. Panajotova - defended, 2000;
2. I.A. Braianov, defended, 2003;
3. I.D. Kandilarov, defended, 2005;
4. M. Koleva, defended, 2007;
5. I.Tr.Angelova, defended, 2008

