Отчет на секция за 2017 г.

Секция: ПАРАЛЕЛНИ АЛГОРИТМИ
Ръководител: доцент д-р Пенчо Маринов

1. *Публикационна дейност*

1.1 *Публикации, отпечатани през 2017 г.*

- ***Научни публикации, които са реферирани и индексирани в световната система за реферирание, индексиране и оценяване - излезли от печат***

1. **Andreev A.B.**, M.R. Racheva. A New Algorithm for Two-sided Eigenvalue Approximation. Comp. rend. Acad. bulg. Sci., 70, 2, „Prof. Marin Drinov“ Publishing House of Bulgarian Academy of Sciences, 2017, ISSN: 1310-1331, 1207-1214. ISI IF: 0.251
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4. Dimitrov, Y., Miryanov, R., **Todorov, V.** Quadrature Formulas and Taylor Series of Secant and Tangent. Economic and Computer Sciences, 4, Publishing house „Knowledge and business“, Varna, 2017, ISSN: 2367-7791, 23-40
5. **Dimov, I.T.,** Dimitrov, S., **Todorov, V.** Latin Hypercube Sampling and Fibonacci Based Lattice Method Comparison for Computation of Multidimensional Integrals. In: Proceeding of Sixth Conference on Numerical Analysis and Applications (NAA'16), LNCS 10187, Springer, 2017, DOI: doi.org/10.1007/978-3-319-57099-0_32, 302-310. SJR: 0.252
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7. **Dimov, I.T.**, Kandilarov, J., Todorov, V., Vulkov, L. High-Order Compact Difference Schemes with Richardson Extrapolation for Semilinear Parabolic Systems. IN: Applications of Mathematics in Engineering and Economics, American Institute of Physics, 1789, 030002, AIP, 2017, DOI: 10.1063/1.4968448, SJR: 0.198
8. **Dimov, I.T.,** Kandilarov, J., **Todorov, V.**, Vulkov, L. Numerical Determination of the Right-hand Side of Parabolic Systems with Point Measurements. AIP Conference Proceedings 1910, 030007 (2017), 1910, 2017, ISSN: 978-0-7354-1602-4, DOI: https://doi.org/10.1063/1.5013966, 030007-1-030007-7. SJR: 0.16
9. P Ellinghaus, J Weinbub, **M Nedjalkov**, S Selberherr. Analysis of Lense-governed Wigner Signed Particle Quantum Dynamics. Physica Status Solidi (RRL)-Rapid Research Letters, 11, 7, (Phys. Status Solidi RRL 7/2017), 2017. Online ISSN: 1862-6270. SJR: 1.237

10. Evtimov G., **Fidanova S.** 2D Optimal Cutting Problem. Studies of Computational Intelligence, 728, Springer, 2018, ISBN: 978-3-319-65529-1, ISSN: 1860-949X, DOI: https://doi.org/10.1007/978-3-319-65530-7_4, 33-39. SJR: 0.187

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13. **Fidanova S.**, Atanassov K. Flying Ant Colony Optimization Algorithm for Combinatorial Optimization. Studia Informatica, 38, 4, Polish Information Society, 2017, ISSN: 1642-0489

14. **Fidanova S.**, Luque G., Roeva O., Paprzycki M., Gepner P. Ant Colony Optimization Algorithm for Workforce Planning. IEEE Xplorer, IEEE catalog number CFP1585N-ART, IEEE, 2017, ISBN: 978-83-946253-7-5, DOI: http://dx.doi.org/10.15439/978-83-946253-7-5, 415-419

15. **Fidanova S.**, Roeva O., Atanassova V. Ant Colony Optimization Application to GPS Surveying Problems: InterCriteria Analysis. Advances in Intelligent Systems and Computing, 559, Springer, 2018, ISBN: 978-3-319-65544-4, ISSN: 2194-5357, DOI: https://doi.org/10.1007/978-3-319-65545-1_23, 251-264

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18. Harizanov, S., Margenov, S., **Marinov, P.**, Vutov, Y. Volume Constrained 2-phase Segmentation Method Utilizing a Linear System Solver Based on the Best Uniform Polynomial Approximation of $x^{-1/2}$. Journal of Computational and Applied Mathematics, 310, C, Elsevier, 2017, ISSN: 0377-0427, DOI: 10.1016/j.cam.2016.06.020, 115-128. ISI IF: 1.357

19. Ismaili S., **Fidanova S.** Representation of Civilians and Police Officers by Generalized Nets for Describing Software Agents in the Case of Protest. Studies of Computational Intelligence, 728, Springer, 2018, ISBN: https://doi.org/10.1007/978-3-319-65530-7_7, ISSN: 1860-949X, 71-78. SJR: 0.187

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21. Krumova, S., Todinova, S., Mavrov, D., **Marinov, P.**, Atanassova, V., Atanassov, K., Taneva, S.G. Intercriteria Analysis of Calorimetric Data of Blood Serum Proteome.

Biochimica et Biophysica Acta (BBA)-General Subjects, 1861, 2, Elsevier, 2017, ISSN: 03044165, DOI: 10.1016/j.bbagen.2016.10.012, 409-417. SJR: 2.128, ISI IF: 5.083

22. **Marinov, P.**, Kutiev, I., Belehaki, A., Tsagouri, A. 3D Electron Density Specification to Support LEO and MEO Satellite Applications. Journal of Atmospheric and Solar-Terrestrial Physics, Elsevier, 2017, ISSN: 1364-6826, DOI: 10.1016/j.jastp.2017.10.003, SJR: 0.76, ISI IF: 1.326

23. Melin, P., Sanchez, D., **Marinov, P.** Intuitionistic Fuzzy Logic Adaptation of Particle Swarm Optimization. Notes on Intuitionistic Fuzzy Sets, 23, 2, IBPhBME - BAS, 2017, ISSN: 1310–4926, 95-102

24. Roeva O., **Fidanova S.** InterCriteria Analysis of Relations Between Model Parameter Estimations and ACO Performance. Studies in Computational Intelligence, 681, Springer, 2017, ISBN: 978-3-319-49543-9, ISSN: 1860-949X, DOI: https://doi.org/10.1007/978-3-319-49544-6_15, 175-186. SJR: 0.235

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30. **Stoimenova, E.** Power of Exceedance-type Tests against Location Shift Alternative. PLISKA, Stud. Math., 27, Institute of Mathematics and Informatics, 2017, ISSN: 0204-9805, 91-102

31. **Stoimenova, E.**, Balakrishnan, N. Sidak-type Tests for the Two-sample Problem based on Precedence and Exceedance Statistics. Statistics, 51, 2, Taylor & Francis, 2017, ISSN: 0233-1888, DOI: http://dx.doi.org/10.1080/02331888.2016.1258071, 247-264. SJR: 0.94, ISI IF: 0.807

32. Zlatev, Z., **Dimov, I.T.,** Farago, I., Georgiev, K., Havasi, A. Stability of the Richardson Extrapolation Combined with Some Implicit Runge–Kutta Methods. Journal of Computational and Applied Mathematics, 310, Elsevier, 2017, ISSN: 0377-0427, 224-240. SJR: 1.08, ISI IF: 1.357

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1. Angelov, S., **E. Stoimenova**. Prediction Error in Multiple Regression Model. Computer Science and Education in Computer Science, 13, New Bulgarian University, 2017, ISSN: 1313-8624, 329-347
2. **Andreev A.B.**, M.R. Racheva. Numerical Aspects for Obtaining Two-sided Bounds of Eigenvalues. International Scientific Journal "Science. Business. Society", 3, Scientific Technical Union of Mechanical Engineering, 2017, ISSN: 2367-8380, 104-107
3. **Andreev, A.B.**, Racheva, M.R. On the Mathematical Model of Rotating Shaft. International Scientific Journal “Industry 4.0”, 2, Scientific Technical Union of Mechanical Engineering, 2017, ISSN: 2534-8582, 81-84
4. Boyanov, K., **Dimov, I.T.**, Sendov, Bl. Bulgarian ICT Security Challenges and Policy for Research Activities. Proceedings of the 10th IT STAR Workshop on IT Security 2017, 9, IT STAR Publications, 2017, ISBN: 978-88-98091-45-4, 45-51
5. **Kapanova, K.G.** Post-learning Strategy and Evolutionary Architecture in Neural Networks. Abstracts of Dissertations, IICT-BAS, Sofia, 8, 2017, ISSN: 1314-6351
6. **Todorov, V.** Monte Carlo Methods for Multidimensional Integrals, Integral Equations and Applications. Abstract of Dissertations, IICT-BAS, Sofia, 3, 2017, ISSN: 1314-6351

7. **Todorov, V.**, **Dimov, I.T.,** Dzurov, V., Stanchev, T., Tsvetkov, I., Dimitrov, V. A Numerical Study on Hammersley Sequence and Fibonacci Based Lattice Rule for Computation of Multidimensional Integrals. Journal Scientific and Applied Research, 12, Konstantin Preslavsky Publishing House, 2017, ISSN: 1314-6289, 18-26
8. **Todorov, V.**, Dzurov, V., Dimitrov, V. A Comparison of Quasi-Monte Carlo Methods Based on Faure and Sobol Sequences for Computation of Multidimensional Integrals, Journal Scientific and Applied Research, Journal Scientific and Applied Research, Konstantin Preslavsky Publishing House, 2017, ISSN: 1314-6289, 11-17

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1.2. Редактирани сборници или тематични броеве на списания

№	вид на продукта	Категория	Наименование	Характеристики	Участници
1	Тематичен сборник	Международно	Recent Advances in Computational Optimization, Results of the Workshop on Computational Optimization WCO 2016	**Studies in Computational Intelligence**, Vol. 717 **Издателство**: Springer, **ISBN:** 978-3-319-59866-4	**Fidanova S.** - Гост-редактор
2	Сборник трудове от научен форум	Международно	Proceedings of the XVII International Summer Conference on Probability and Statistics	**Издателство**: Institute of Mathematics and Informatics, Sofia, **ISBN:** 978-954-8986-46-5	**Stoimenova, E.** - Редактор Bojkova, M. - Редактор

1.4. Цитати и/или отзиви, публикувани през 2017 г. с изключени самоцитати

Брой цитирани публикации: 118	**Брой цитиращи източници: 223**

1988

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Аналитичен отчет на секция за 2017 г.

2.1 Полза / ефект за обществото от извършваните дейности

Методите Монте Карло (МК) са много важни в изчислителната физика, като моделиране на електронен и радиационен транспорт, в статистическата физика, в молекулното моделиране, като алтернатива на изчислителната молекулярна динамика. Квантовите методи МК имат приложение в квантовата механика. Много от клоновете на науката са свързани с квантовата механика и кохерентните явления. Някои от възможните приложения на тази тематика са в: изчислителната химия - за създаване на нови и по-ефективни лекарства; физика на полупроводниците - за създаване на нови електронни устройства; квантовите изчисления, които водят до създаването на нови изчислителни устройства за обработка на информация. МК методите се използват широко в инженерството за анализ на чувствителността и количествен вероятностен анализ в процеса на проектиране.

Оптимизацията представлява целенасочена дейност за получаване на най-добър резултат в някакъв смисъл. Обект на оптимизация може да бъде както производствен процес, така и човешка дейност. Като примери могат да се посочат разпределението на бюджет, разпределението на доставки при наличие на много заявки и средства за доставяне, наемането на персонал, разпределението на задания към изпълнители, изрязването на фигури с неправилна форма с минимум отпадък с приложение в строителството при изработка на метални конструкции, конструиране на безжични сензорни мрежи с минимум сензори и минимална консумация на енергия, проследяване на GPS мрежа и др. Някои задачи за моделиране на процеси се свеждат до намиране на оптимални параметри на модела. Голяма част от оптимизационните задачи от реалния живот и индустрията имат експоненциална сложност. За тяхното решаване се разработват стохастични методи, които да дадат приближено решение за разумно време. Приложен е интеркритериален анализ върху разработените алгоритми. Целта е намиране на степента на свързаност между отделните критерии при решаването на дадена задача и нейното опростяване, без това да води до влошаване на получените резултати, а от там и повишаване на бързодействието при внедряване на съответните алгоритми.

Използвани са разнообразни методи за моделиране, като обобщени мрежи, приложени за моделиране на железопътен транспорт, многоагентни системи, приложени за моделиране на поведението на големи групи от хора и възникване на конфликтни ситуации. Разработен е метод за тримерно моделиране на йоносферни явления. Тези изследвания са важни за коригиране на смущенията при ефирно предаване на данни и устройства, използващи GPS. Разработени са методи за обработка и сравнение на медицински данни, като белтъчен състав на кръвен серум. Изследвани са данни от четири фази на епилептичен пристъп. Подробно е изследван спектъра на измерените сигнали. На основа на проведения анализ е направена хипотеза за това кои изменения в спектъра са предвестници на епилептичен пристъп.

Опазването на околната среда се нарежда сред водещите приоритети в цял свят. И през тази година продължи разработването и прецизирането на Датския Ойлеров модел за пренос на замърсители във въздушна среда. Изследвана е чувствителността на разработените алгоритми към промяната на входните данни и параметрите.

Тези разработки са свързани с три проекта, финансирани от Националния фонд за научни изследвания.

2.2. Взаимоотношения с институции

Членовете на секцията са представили общо 12 рецензии и становища за присъждане на научни степени и звания и 174 рецензии за научни издания.
Един член на колектива (проф. Андрей Андреев) е бил председател на две комисии за акредитация на висши учебни заведения, съответно на Шуменски университет и Великотърновски университет.

3. РЕЗУЛТАТИ ОТ НАУЧНАТА ДЕЙНОСТ ПРЕЗ 2017 г.:

3.1. **Най-значимо постижение.**

СТОХАСТИЧНИ АЛГОРИТМИ ЗА РЕШАВАНЕ НА ГОЛЕМИ ИЗЧИСЛИТЕЛНИ ЗАДАЧИ

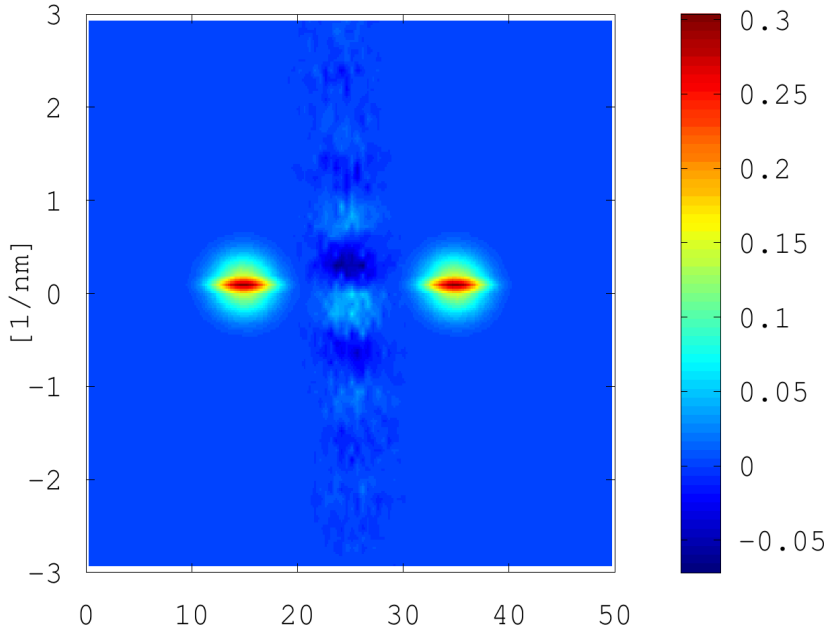
Разработени са Монте Карло методи с приложение в изчислителната физика, като моделиране на електронен и радиационен транспорт, в статистическата физика, в молекулното моделиране. Квантовите методи Монте Карло имат приложение в квантовата механика, като някои от приложенията са в изчислителната химия за създаване на нови ефективни лекарства, във физиката на полупроводниците за създаване на нови електронни устройства, анализ на химични и физични процеси, протичащи при преноса на замърсители и др.

Разработени са стохастични алгоритми за решаване на сложни оптимизационни задачи. Тези алгоритми имат приложение в моделирането на биореактор за производство на лекарствени субстанции, наемане и разпределение на работна сила, изрязване на метални планки с неправилна форма с минимален отпадък с приложение в строителството при изработка на метални конструкции, оптимално разпределение на бюджет. Някои задачи за моделиране на процеси се свеждат до намиране на оптимални параметри на модела.

Разработени са методи за статистическо моделиране. Тези модели се прилагат в анализ на данни и за увеличаване на точността на резултатите от емпирични изследвания.

Постигнатите резултати са публикувани в общо над 20 публикации, като 8 от тях са научни статии в списания с импакт-фактор Thomson Reuters (от 0.807 до 2.92) и 10 в издания с SJR ранг на SCOPUS.

Ръководител на колектива: проф. Стефка Фиданова.



Фиг. 1. *Развитие на система от две или повече частици (електрони) в отворена термодинамична среда.*

3.2. ***Най-значимо приложно постижение***

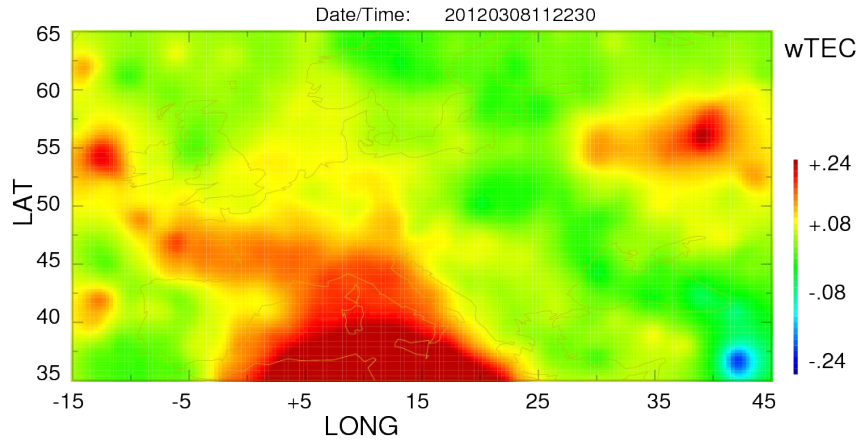
МЕТОДИ ЗА ИЗВЛИЧАНЕ И ОБРАБОТКА НА ДАННИ ОТ ПРИРОДНИ ЯВЛЕНИЯ И МЕДИЦИНАТА

Разработен е метод за тримерно моделиране на йоносферни явления. С него се проследяват изменения в концентрацията на йоносферата в следствие на слънчеви бури. Тези изследвания са важни за предвиждане и коригиране на смущения в ефирното излъчване, както и при използване на GPS данни.

Разработени са методи за сравнителен анализ на белтъчния състав на кръвен серум на различни групи пациенти.

Постигнатите резултати са публикувани в 3 научни статии в списания с импакт-фактор Thomson Reuters (от 1.32 до 5.083).

Ръководител на колектива: доц. Пенчо Маринов.



Фиг. 2. *Йоносферни смущения над територията на Европа - Северен Атлантик.*

4. МЕЖДУНАРОДНО НАУЧНО СЪТРУДНИЧЕСТВО НА ЗВЕНОТО:

4.1 Организиране на международни конференции

- **Workshop on Combinatorial Optimization 2017** – Прага, Чехия. Десетият „**Workshop on Combinatorial Optimization**“ се проведе в рамките на FedCSIS'2017 http://fedcsis.org/wco/. Бяха изпратени над 35 статии, като 20 от тях бяха приети за докладване и включени в тома от конференцията. Участниците в конференцията бяха от 13 държави, както следва: Австралия, Австрия, България, Великобритания, Испания, Перу, Парагвай, Франция, Полша, Турция, Южна Африка, Унгария, Япония. Трудовете на конференцията са достъпни в IEEE Xplorer и имат импакт ранг. Разширени версии на приетите и изнесени доклади се публикуват в реномираната поредица Studies in Computational Inelligence на издателство Springer, която има SJR ранг.

5. УЧАСТИЕ НА ЗВЕНОТО В ПОДГОТОВКАТА НА СПЕЦИАЛИСТИ: ФОРМИ, СЪТРУДНИЧЕСТВО С УЧЕБНИ ЗАВЕДЕНИЯ, ВЪНШНИ ЗАЯВИТЕЛИ, ВКЛЮЧИТЕЛНО ОТ ЧУЖБИНА.

- 1. проф. Стефка Фиданова, ERASMUS със Southampton Solent University
- 2. проф. Стефка Фиданова, COST Action 1207 – делегат в управителния съвет