Olga Parshina | Ph.D.

Current research

Discrete and computational mathematics: Graph theory, coding theory, automata theory, combinatorics on words, algebraic combinatorics, optimization, numerical analysis.

My current research has two main directions: one concerns investigation of regular structures in infinite aperiodic words; another one aims to study problems of characterization of equitable partitions (partition designs) in transitive graphs.
I am a participant of two science-intensive projects connected with discrete optimization and numerical analysis, more details below.

Professional & research experience

Saint Petersburg State University — **Saint Petersburg, Russia**
Researcher (Postdoctoral fellowship) — *September 2020 — ...*

Czech Technical University in Prague — **Prague, Czech Republic**
Researcher (Postdoctoral fellowship) — *November 2019 — August 2020*

Institut Camille Jordan UCBL1 — **Lyon, France**
Invited researcher (via Labex MILYON) — *September 2019 — October 2019*

Sobolev Institute of Mathematics SB RAS — **Novosibirsk, Russia**
Researcher — *September 2015 — August 2019*

Sobolev Institute of Mathematics SB RAS — **Novosibirsk, Russia**
Researcher, *part-time* — *September 2013 — August 2015*

Industrial projects

Huawei & SPbU

"Automated Multi-Layer PCB Wiring", *Developer & analyst* — *2020 — 2021*

Annotation. A printed circuit board (PCB) is a laminated sandwich structure of conductive and insulating layers. The task was to design an algorithm that allows to connect pins placed on the PCB with wires meeting certain restrictions on width, mutual distance, the number of bends etc. The complexity status of the stated problem is unknown; though some of its simplified versions seem to be NP-complete.
The solution implemented by our team is the fusion of the exact techniques with heuristic algorithms in a way that allows to connect the pins with a reasonable execution time.
I took part in developing the algorithm that meets the requirements of the problem; my role was also to analyze the implemented code and write the technical reports.

Collaboration with M. Darienzo & INRAE Lyon

"Probabilistic Segmentation Method Accounting for Data Uncertainties", *Java Developer* — *In progress*

Annotation. Development of a Java graphical interface for the R / fortran software developed by M. Darienzo which performs recursive probabilistic segmentation on data affected by uncertainties. This method takes into account data uncertainties (potentially large and variable) through a Bayesian and Monte Carlo approaches (multi-block adaptive metropolis algorithm, BaM, B. Renard). The user can interact by modifying the various settings that regulate the algorithm and the resulting graph.

Teaching experience

St Petersburg State University — **St Petersburg, Russia**
Mathematics & Computer Science Department — *September — December, 2021*
Set Theory, practice part, 32h

St Petersburg State University — **St Petersburg, Russia**
Mathematics & Computer Science Department — *September — December, 2020 & 2021*
Theoretical Computer Science, practice part, 64h

St Petersburg State University — **St Petersburg, Russia**
Mathematics & Computer Science Department — *February — May, 2021*
Computability Theory, practice part, 32h

University Claude Bernard Lyon 1 — **Villeurbanne, France**
Algebra, practice part, 24h — *January — May, 2019*

Novosibirsk State University — **Novosibirsk, Russia**
Department of Natural Sciences — *September — December, 2015*
Algebra, practice part, 32h

Lyceum school No 6 — **Berdsk, Russia**
Programming (C++), 128h — *October 2013 — June 2016*
Cryptography and Number Theory, 256h

Education

PhD thesis: Regularity in morphic words and in colorings of infinite circulant graphs

Date of defense: May 29, 2019

Thesis program: International joint thesis supervision between

- Sobolev Institute of Mathematics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia
  Advisor: Sergey V. Avgustinovich
- Institut Camille Jordan, University Claude Bernard Lyon 1 Villeurbanne, France
  Advisor: Luca Q. Zamboni

M.Sc. Mathematics and Computer Science (cum laude) — **Novosibirsk, Russia**
Novosibirsk State University, *full tuition scholarship* — *2013 — 2015*
Department of Mathematics and Mechanics, Theoretical Cybernetics

B.Sc. Applied Mathematics and Informatics — **Novosibirsk, Russia**
Novosibirsk State University, *full tuition scholarship* — *2009 — 2013*
Department of Mathematics and Mechanics, Theoretical Cybernetics

Languages

Russian: Mothertongue

English: Fluent

French, Italian: Intermediate

Czech, German: Basic

Computer skills

Languages and Scripts: C/C++, Python, Java, SQL

Software: Visual Studio, PyCharm, Jupiter, SageMath, Eclipse, PostgreSQL, Maple, LaTeX, MS/Open Office

Scientific awards & grants

Research grants

Russian Foundation for Basic Research grant
Leader, *project No 18-31-00009* *2018 — 2020*
Project "Structural properties of morphic words and of infinite transitive graphs perfect colorings"

Russian Science Foundation grant
Participant, *project No 14-11-00555* *2015*
Project "Intersections of discrete spaces in problems of coding theory and algebraic combinatorics"

Grant of the president of Russia for leading scientific schools
Participant, *project SS-1939.2014.1* *2014*

FTP "Scientific and scientific-pedagogical personnel of Russia"
Participant, *Agreement No 8227* *2009 — 2013*

Mobility programs and travel grants

Program of incoming mobility IDEX
IDEXLYON *2019*
Funding of six months research stay at Institut Camille Jordan

Program of incoming mobility PALSE
Lyon Saint-Étienne program *2017*
Funding of four months research stay at Institut Camille Jordan

LABEX MILYON (ANR-10-LABX-0070)
participant, ANR-11-IDEX-0007 *2016 — 2019*

Academic mobility travel grant
Mikhail Prokhorov Foundation grant *May 2015*
Participation in the conference "WORDS-2015", Kiel (Germany), September 14–17, 2015

Scholarships and other awards

Vernadsky scholarship
Embassy of France in Russia joint PhD scholarship program *2016 — 2019*

Lyapunov prize for Master students
Novosibirsk State University *June 2015*

International Scientific Student Conference Diploma of II degree
Novosibirsk State University *April 2015*

Science popularisation

Summer school of Russian Reporter Magazine **Dubna, Russia**
Mathematics lecturer *July, 2014*

Short science-pop videos about real-life applications of mathematics [RU]
Youtube link: `A bit about mathematics`

Publications

Papers in international peer-reviewed journals

1. On perfect colorings of infinite multipath graphs (with Avgustinovich S. V. & Lisitsyna M. A.), *Siberian Electronic Mathematical Reports*, **17** (2020) pp. 1863 –1868.
   DOI:10.33048/semi.2020.17.139
2. Perfect 2-colorings of the infinite circulant graph with a continuous set of odd distances (with Lisitsyna M. A.), *Siberian Electronic Mathematical Reports*, **17** (2020) pp. 590–603.
   DOI: 10.33048/semi.2020.17.038
3. Open and closed factors in Arnoux-Rauzy words (with Zamboni L. Q.), *Advances in Applied Mathematics*, **107** (2019), pp. 22–31.
   DOI: 10.1016/j.aam.2019.02.007, *also available at* arXiv:1810.05472.
4. Perfect colorings of the infinite circulant graph with distances 1 and 2 (with Lisitsyna M. A.), *Journal of Applied and Industrial Mathematics* **11(3)** (2017) pp. 381–388.
   DOI: 10.1134/S1990478917030097
5. On the cardinality of vectors support in coordinate transitive linear spaces (with Avgustinovich S. V.) [RU], *Siberian Electronic Mathematical Reports*, **12** (2015), pp. 960–966.
   DOI: 10.17377/semi.2015.12.082
6. Perfect 2-colorings of infinite circulant graphs with a continuous set of distances, *Journal of Applied and Industrial Mathematics* **8(3)** (2014) pp. 357–361.
   DOI: 10.1134/S1990478914030077

Papers in international peer-reviewed conference proceedings

1. On closed-rich words (with Puzynina S. A.), *In: Santhanam R., Musatov D. (eds) Computer Science – Theory and Applications. CSR 2021. Lecture Notes in Computer Science, vol 12730. Springer,* pp. 381–394.
   DOI:10.1007/978-3-030-79416-3_23
2. On arithmetic index in the generalized Thue-Morse word, *In: Brlek S., Dolce F., Reutenauer C., Vandomme É. (eds) Combinatorics on Words. WORDS 2017. Lecture Notes in Computer Science, vol 10432. Springer*, pp. 121–131.
   DOI: 10.1007/978-3-319-66396-8_12, *also available at* arXiv:1811.03884.
3. On arithmetic progressions in the generalized Thue-Morse word, *In: Manea F., Nowotka D. (eds) Combinatorics on Words. WORDS 2015. Lecture Notes in Computer Science, vol 9304. Springer*, pp. 191–196.
   DOI: 10.1007/978-3-319-23660-5_16

Papers submitted to international peer-reviewed journals

1. Open and closed complexity of infinite words (with Postic M.), *available at* arXiv:2005.06254
2. Finite and infinite closed-rich words (with Puzynina S. A.), *available at* arXiv:2111.00863

Conference abstracts

1. Open and closed factors in Arnoux-Rauzy words (with Zamboni L. Q.), *Abstracts of the conference "Mons Theoretical Computer Science Days"*, September 10–14, 2018, pp. 17–20.
   Available at Mons_Days.

2. Perfect 2-colorings of infinite circulant graphs with a continuous set of odd distances (with Lisitsyna M. A.), *Abstracts of the International Conference and PhD Summer School "Groups and Graphs, Representations and relations",* Novosibirsk, Russia, August 06–19, 2018, p. 74. *Available at* `G2R2`.
3. On perfect 2-colorings of infinite multipath graphs (with Lisitsyna M. A.), *Abstracts of the International Conference and PhD Summer School "Groups and Graphs, Representations and relations",* Novosibirsk, Russia, August 06–19, 2018, p. 64. *Available at* `G2R2`.
4. Perfect k-colorings of infinite circulant graphs with a continuous set of distances, *Abstracts of the International Conference and PhD Summer School "Groups and Graphs, Algorithms and Automata",* Ekaterinburg, Russia, August 09–15, 2015, p. 80. *Available at* `G2A2_Parshina`.
5. On length of arithmetic progressions in the Thue-Morse word [RU], *Abstracts of the International Scientific Student Conference,* Novosibirsk, Russia, April 11–18, 2014.
6. Perfect colorings of circulant graphs with a continuous set of distances [RU], *Abstracts of the International Scientific Student Conference,* Novosibirsk, Russia, April 12–18, 2013.
7. Perfect 2-colorings of infinite circulant graphs with a continuous set of distances [RU], *Abstracts of the International conference "Mal'tsev Meeting",* Novosibirsk, Russia, November 12–16, 2012, p. 73. *Available at* `MalMeeting`.
8. On perfect 2-colorings of circulant graphs [RU], *Abstracts of the International Scientific Student Conference,* Novosibirsk, Russia, April 13–19, 2012.

Conferences, seminars & schools

Conference talks

1. On closed-rich words (with Puzynina S. A.), *The 16th International Computer Science Symposium in Russia*, Sochi, Russia, June 28–July 2, 2021.
2. On closed factors, complexity and periodicity in infinite sequences, *New Year Colloquia — Mathematics and Computer Science*, St Petersburg, Russia, December 27, 2020 — January 8, 2021.
3. Open and closed factors in Arnoux-Rauzy words (with Zamboni L. Q.), *"Mons Theoretical Computer Science Days"*, Talence, France, September 10–14, 2018.
4. Perfect 2-colorings of infinite circulant graphs with a continuous set of odd distances (with Lisitsyna M. A.), *International Conference and PhD-Master Summer School on Graphs and Groups, Representations and Relations,* Novosibirsk, Russia, August 6–19, 2018.
5. Open and closed factors of Arnoux-Rauzy words, *Workshop on Words and Complexity*, Villeurbanne, France, February 19–23, 2018.
6. On Arithmetic Index in Generalized Thue-Morse Word, *International Conference "WORDS-2017",* Montreal, Canada, September 11–15, 2017.
7. On arithmetic index in the Thue-Morse word, *CANT 2016 — Combinatorics, Automata and Number Theory international school and conference*, Marseille, France, November 28–December 2, 2016.
8. Tilings and finite abelian groups (with Avgustinovich S.V.), *Conference and thematic school "Transversal aspects of tilings",* La Vieille Perrotine, Oléron, France, May 30–June 12, 2016.

9. On arithmetic index of subsequences in the Thue-Morse word, *Young Researches International School and Conference "Modern Problems of Mathematics and its Applications",* Ekaterinburg, Russia, January 31–February 6, 2016.
10. On Arithmetic Progressions in Generalized Thue-Morse Word, *International Conference "WORDS-2015",* Kiel, Germany, September 14–17, 2015.
11. Perfect k-colorings of infinite circulant graphs with a continuous set of distances, *International Conference and PhD Summer School "Group and Graphs, Algorithms and Automata",* Ekaterinburg, Russia, August 9–15, 2015.
12. On arithmetic progressions in the Thue-Morse word, *Workshop on Automatic Sequences,* Liège, Belgium, May 25–29, 2015.
13. Homogeneous arithmetic progressions in the Thue-Morse word, *International Scientific Student Conference,* Novosibirsk, Russia, April 11–17, 2015.
14. On length of arithmetic progressions in the Thue-Morse word, *International Scientific Student Conference,* Novosibirsk, Russia, April 11–18, 2014.
15. Perfect colorings of circulant graphs with a continuous set of distances, *International Scientific Student Conference,* Novosibirsk, Russia, April 12–18, 2013.
16. Perfect 2-colorings of infinite circulant graphs with a continuous set of distances, *International conference "Mal'tsev Meeting",* Novosibirsk, Russia, November 12–16, 2012.
17. On perfect 2-colorings of circulant graphs, *International Scientific Student Conference, Novosibirsk,* Russia, April 13–19, 2012.

Seminar talks

1. A few words on combinatorics, *Young Researchers' Seminar,* SPbU, Dept. of Mathematics & Computer Science, St Petersburg, Russia, October 15, 2021.
2. Arithmetic structures in infinite words, *Students' Colloquium,* SPbU, Dept. of Mathematics & Computer Science, St Petersburg, Russia, November 19, 2020.
3. Regularity problems in combinatorics on words, *EIMI Postdoc Seminar,* Euler International Mathematical Institute, St Petersburg, Russia, November 2, 2020.
4. On perfect colorings of infinite circulant graphs, *Coding theory seminar of Dobrushin Mathematics Laboratory,* The Institute for Information Transmission Problems, Moscow, Russia, May 21, 2019.
5. On periodic structures in morphic words and in colorings of infinite circulant graphs, *Theoretical Cybernetics Department Seminar,* Sobolev Institute of mathematics SB RAS, Novosibirsk, Russia, March 14, 2019.
6. On periodic structures in morphic words and in colorings of infinite circulant graphs, *"Coding theory",* Sobolev Institute of mathematics SB RAS, Novosibirsk, Russia, March 12, 2019.
7. Perfect colorings of infinite circulant graphs with a continuous set of odd distances (with Lisitsyna M. A.), *"2018-ary quasigroups and related topics",* Sobolev Institute of mathematics SB RAS, Novosibirsk, Russia, August 10, 2018.
8. Open and closed factors in Arnoux-Rauzy words (with Zamboni L. Q.), *"Coding theory",* Sobolev Institute of mathematics SB RAS, Novosibirsk, Russia, April 3, 2018.
9. Arithmetic subsequences in morphic words, *"Combinatorics and Number theory"*, Institut Camille Jordan UCBL1, Villeurbanne, France, May 16, 2017.
10. On arithmetic progressions in the Thue-Morse word, *"Coding theory",* Sobolev Institute of mathe-

matics SB RAS, Novosibirsk, Russia, May 18, 2015.

11. On perfect 2-colorings of infinite circulant graphs with a continuous set of distances, *"Coding theory",* Sobolev Institute of mathematics SB RAS, Novosibirsk, Russia, May 21, 2013.
12. Quantum computer and quantum cryptography, *"Cryptography and Cryptanalysis"*, Novosibirsk State University, Novosibirsk, Russia, November 13, 2011.

Other schools and conferences attended

1. International conference "WORDS-2019", Loughborough, England,UK, September 9–13, 2019
2. Spring School in Mathematical Computer Science, Marseille, France, March 4–8, 2019
3. Conference "Algebra and Combinatorics at LaCIM",Montreal, Canada, September 24–28, 2018
4. MathExp 2018 "Mathématiques expérimentales: méthodes et pratiques", Saint Flour, France, May 21–June 1, 2018
5. Colloque Inter'Actions en Mathématiques 2018, Lyon, France, May 14–18, 2018
6. Workshop on Ramsey Theory of Equations and related topics, Pisa, Italy, February 16–17, 2018
7. Conference "Tiling and Recurrence", Marseille Luminy, France, December 4–8, 2017
8. School and workshop "Ultrafilters, Ramsey Theory and Dynamics", Lyon, France, November 20–24, 2017
9. Research School on Aperiodicity and Hierarchical structures in tilings, Lyon, France, September 18–22, 2017
10. New Advances in Symbolic Dynamics (CNRS Thematic School), Marseille Luminy, France, January 30–February 3, 2017
11. G2S2 — International Conference and PhD-Master Summer School on Graphs and Groups, Spectra and Symmetries, Novosibirsk, Russia, August 15–28, 2016