

Curriculum Vitae

Sergey Kitaev

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Education

2003: **PhD in Mathematics**, Gothenburgh University; "Generalized patterns in words and permutations"

1998: **M.Sc. in Applied Mathematics and Informatics**, Novosibirsk State University

1996: **B.Sc. in Mathematics** (A Diploma), Novosibirsk State University

Employment

2011-now: **Reader**, University of Strathclyde

2006-2011: **Associate Professor of Mathematics**, Reykjavik University

2005-2006: **Assistant Professor of Mathematics**, Reykjavik University

2005: **Visiting Assistant Professor**, University of California, San Diego

2003-2004: **Visiting Assistant Professor**, University of Kentucky

Research leadership

I am the author of **143 publications** including **100 peer-reviewed journal articles** in **Combinatorics, Graph Theory, Algebra, Discrete Mathematics, and Formal Language Theory**; see

<https://personal.cis.strath.ac.uk/sergey.kitaev/publications.html>

However, my research leadership is better demonstrated by me being the author of the **only comprehensive book** published by *Springer* about a fast growing research area, with hundreds of researchers around the globe actively involved, and over a thousand papers published to date. I am an **international leader** in this field that has numerous applications in various branches of mathematics, computer science, biology and theoretical physics. Moreover, **my other book** published by *Springer* introduces the reader to a theory **I have pioneered alone**, a field enjoying ever greater attention by other researchers, and with the ultimate goal of finding applications for analysis of algorithms on graphs and robot scheduling. As an internationally recognised scientist, I have been the **chair of organising committees** of several international conferences/symposia/workshops, most notably the **British Combinatorial Conference** in 2017, probably the **world's most prestigious** general conference in Combinatorics. Also, I am a *reviewer* for **Math Reviews (75 reviews)** and I have done referee work for **47 journals**. I have given **171 talks** for various audiences; see

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I am cited **1814** times on Google Scholar (as of **Sept 2019**); **h-index** is **22**. I am listed among the **most cited mathematicians** based on graduation year: sites.google.com/view/mathematiciancitations/home

I have been a **reviewer** for *EPSRC, NSA Math. Sciences Grant Program, Russian Science Found., Ministry of Education and Science of Russian Federation, and South Africa's National Research Found. (NRF)*

Research monographs and books edited

S. Kitaev. Patterns in permutations and words. *Springer*, 2011 (**516 pages**)

S. Kitaev, V. Lozin. Words and graphs. *Springer*, 2015 (**282 pages**)

Surveys in Combinatorics 2017. Edited by Claesson et al., *Cambridge University Press*, 2017

Permutation Patterns 2012 Special Issue of "Pure Math. & Appl.". Edited by Claesson and **Kitaev**, 2012

Plenary/invited talks

Algorithms and Software for Discrete Computat. Math., CoDiMa Workshop, Univ. of Manchester, May 2019

One-Day-Meeting in Combinatorics, Sungkyunkwan University, Korea, April 2019

Theoretical and Computational Discrete Mathematics (**TCDM**), Univ. of Derby, UK, Sept 2018

5th International Conference on Riordan Arrays and Related Topics (**SRART**), Korea, June 2018

21st Int. Conference on Developments in Language Theory (**DLT**), Univ. of Liège, Belgium, August 2017

Open School on Comb. Methods in Analysis of Alg. and Data Struct., Sungkyunkwan Univ, Korea, Feb 2017

One-Day-Meeting in Combinatorics, Sungkyunkwan University, Korea, Sept 2017

Scottish Combinatorics Meeting, University of Glasgow, Apr 2015

12th International Permutation Patterns Conference (**PP**), East Tennessee State University, July 2014

AMS-MAA joint meetings in 2010 and 2013 at San Francisco and San Diego, respectively

Invited colloquium talks at Departments of Mathematics

Nihon University, Japan (2018); Sungkyunkwan University, Korea (2017); University of California, San

Diego (2013, 2012); California Polytechnic State University (2012, 2011, 2010); University of St Andrews

(2013, 2011); California State University, Los Angeles (2010, 2009)

Organisation of scientific meetings and Program Committees

PC member, 13th International Conf. on **Language and Automata Theory and Applications**, LATA 2019
The *organiser* of the workshop in combinatorics at **British Mathematical Colloquium**, BMC 2018
Chairman of the organising committee, 26th **British Combinatorial Conference**, BCC 2017
The *organiser* of the mini-symposium "Patterns in permutations and words" at BCC 2017
Chairman of the organising committee, 10th Conference on **Permutation Patterns**, PP 2012
Member of the organising committee, **Formal Power Series and Algebraic Combinatorics**, FPSAC 2011
Chairman of the organising committee, 10th **Nordic Combinatorial Conference**, NORCOM 2010
Member of the organising committee, 4th **Permutation Patterns**, PP 2006

Journal editorial board membership

Journal of Discrete Mathematics (JDM; 2012-2016), Open Journal of Discrete Mathematics (OJDM; 2010-2013), PP 2012 Special Issue of "Pure Mathematics and Applications" (Pu.M.A.; guest editor)

Grants

8,200 GBP from *London Mathematical Society* in total for the period 2015-2018
3,495 GBP from *Edinburgh Mathematical Society* in total for the period 2012-2016
3,000 GBP from *Glasgow Mathematical Journal Trust*, 2015
4,203 GBP, Global Engagements in Research, *University of Strathclyde* and *EPSRC*, 2013, 2014 and 2018
2,300 GBP from *EPSRC Vacation Bursary Programme* to supervise a research project, 2014
11,000 GBP, *University of Strathclyde Faculty of Science Grant*
39,800 EUR, **highly competitive** "Abel Extraordinary Chair" from *Universidad Complutense de Madrid*, Spain for 6 month research stay at *Universitat Politècnica de Catalunya*, 2010
600,000 USD, co-investigator, grant for Excellence from *Iceland Science Found.*, 2009
300,000 USD, co-investigator, grant for Excellence from *Iceland Science Found.*, 2006

Postdoctoral mentor for

Amy Glen 2008-2009 (Murdoch Univ.), Vit Jelinek 2009-2010 (Charles Univ.), Pavel Salimov 2011 (Excelsior LLC), Chris Severs 2011 (eBay), Henning Ulfarsson 2010-2011 (Reykjavik Univ.)

PhD students: Marc Glen (2019), Kittitai Iamting (since 2018)

Short- and long-term research visits

2019: **Center for Applied Mathematics, Tianjin University**, China (Prof. William Chen)
2019, 2018, 2017: **Sungkyunkwan University**, Korea (Prof. Gi-Sang Cheon)
2019, 2018: **Nihon University**, Japan (Prof. Akira Saito)
2018 - 2014, 2012, 2011, 2009: **Sobolev Institute of Mathematics**, Russia (Prof. Sergey Avgustinovich)
2018, 2017, 2015, 2014: **Nankai University**, China (Prof. William Chen, Prof. Arthur Yang)
2017: **Fudan University**, China (Prof. Hehui Wu)
2017: **Shanghai Jiao Tong University**, China (Prof. Yakon Wu, Prof. Jun Ma)
2016, 2015: **University of Bourgogne**, France (Prof. Vincent Vinovszki)
2014, 2013, 2012, 2011, 2010, 2009, 2006: **University of California, San Diego**, US (Prof. Jeffrey Remmel)
2013, 2011, 2007: **University of St Andrews**, UK (Prof. Nik Ruskuc)
2012: **University of Warwick**, UK (Prof. Vadim Lozin)
2010: **Universitat Politècnica de Catalunya**, Spain (Prof. Marc Noy)
2010: **Jagiellonian University in Kraków**, Poland (Prof. Włodzimierz Moczurad)
2005: **Mittag-Leffler Institute**, Sweden (Program in Algebraic Combinatorics)

Research and administrative related activities and commissions of trust

Director of Internationalisation, Computer and Inf. Sciences Dept, Univ. of Strathclyde (since 2018)

Director of Research, Computer and Information Sciences Dept, Univ. of Strathclyde (2014-2017)

Director of Departmental Graduate Program, University of Strathclyde (2013-2014)

Member of **British Combinatorial Committee** (2015-2017)

Member of **Steering Committee for the conference "Permutation Patterns"** (since 2014)

Member of **Edinburgh Mathematical Society** (since 2012)

Member of **Knowledge Exchange Committee**, University of Strathclyde (2015-2016)

Member of **Departmental Industrial Advisory Board**, University of Strathclyde (2013-2015)

Member of **Departmental Management Team**, University of Strathclyde (2012-2016)

Member of **Icelandic Center of Excellence in Theoretical Computer Science, ICE-TCS** (2005-2011)

Examiner for PhD defences (vivas): McDevitt (St Andrews, 2019), Collins (Warwick, 2017), Smith (Strathclyde, 2015), Hoffmann (St Andrews, 2015), Hannah (Strathclyde, 2015), Purcell (Warwick, 2013), Bell (Lancaster, 2011)

External Examiner for the *MSc Applicable Mathematics programme* at the **London School of Economics and Political Science**, one of world's top institutions (2016-2019)

Ten years track-record

Ten year track-record highlights

- Published **two books** with *Springer* and edited **two books**;
- Published **68 peer-reviewed journal papers** and **14 conference proceedings**; see <https://personal.cis.strath.ac.uk/sergey.kitaev/publications.html>
- Gave **111 talks** including **7 plenary/invited talks** at international conferences, **11 invited colloquium talks**, talks at international **BCC 2017**, **PP 2012**, **FPSAC 2010**, **DLT 09**, **LATA 2018**; see <https://personal.cis.strath.ac.uk/sergey.kitaev/talks.html>;
- **Chaired** organisation of **3 major international conferences** including **British Combinatorial Conference**, a world's primary confer. in combinatorial math.; was the organiser of **Combinatorics workshop** at **BMC 2018** and a **mini-symposium** at **BCC 2017**; organised **FPSAC 2011**;
- Obtained **£67,462 UK/EU** research funding; co-recipient of **\$600,000** from *Iceland Science Found.*
- Served as a **reviewer** for *EPSRC*, *NSA Math. Sciences Grant Program*, *Russian Sci. Found.*, *Ministry of Education and Sci. of Russian Federation*, and *South Africa's National Research Found.*
- Reached **1814 citations** on Google Scholar (**Sept 2019**); **h-index=22**; Listed among the **most cited mathematicians** based on graduation year: sites.google.com/view/mathematiciancitations/home
- Carried out **33 research visits** to institutions in Europe, US, China, Japan, Korea and Russia;
- Collaborated with **55+ researchers**, see <https://personal.cis.strath.ac.uk/sergey.kitaev/coauthors.html>
- Built solid research links with several combinatorial centres around the globe including the **Center for Combinatorics (CFC)** at *Nankai University* in China, and the **Applied Algebra and Optimization Research Center (AAOR)** at *Sungkyunkwan University* in South Korea;
- Was **Examiner** for **6 PhD defences (vivas)**;
- Am **External Examiner** (2016-2019) for the *MSc Applicable Mathematics programme* at the **London School of Economics and Political Science**, one of world's top institutions;
- Received **Strathclyde Teaching Excellence Award** for being *supportive teacher* in 2016;
- Served as **Director of Research**, **Director of Internationalisation**, **Director of Graduate Studies**.

Selected achievements over the last ten years

My book "Patterns in permutations and words" (published by *Springer* in *EATCS monographs in Theoretical Computer Science* book series in **2011**) is the **only one comprehensive survey to date** on existing literature and modern research directions in a **very active** area of research with **hundreds of researchers** around the globe involved, and over a **thousand papers** published to date.

In **2010**, in collaboration with other researchers, I enumerated **interval orders**, a classical object introduced by *Fishburn*, thus settling a **40+ years old problem**. The respective paper has been very influential and it was "the **most cited paper** published by the *Journal of Combinatorial Theory, Series A*, in the last five years". This journal is widely regarded as the **most prestigious journal** in combinatorics. As a byproduct of this result, we proved a **conjecture** of *Jovovic* in the theory of matrices and a **conjecture** of *Pudwell* in the theory of permutation patterns.

My second Springer book "Words and Graphs", written in collaboration with *Lozin* in **2015**, introduces the reader to the **theory of word-representable graphs** I have pioneered alone, a field enjoying ever greater attention by other researchers. These graphs do not only generalise several well-known classes of graphs and are interesting from the algorithmic point of view, but also can be linked to robot scheduling. The book is based on **17 research papers**, but it also includes a number of **original results**. I have big plans for further development of the theory and its generalisations.

In collaboration with *Seif*, in **2008**, I solved the **word problem for Perkins semigroup** in terms of certain digraphs. The semigroup has played central role in *semigroup theory* since 1960, particularly as a source of examples and counterexamples.

Tutte introduced planar maps in 1960s in connection with what later became the celebrated **Four Color Theorem**. Even though **self-dual graphs** were well studied, nothing was known about **self-dual maps**, and in particular, their enumeration remained an open problem for **50+ years**. In collaboration with *de Meir* and *Noy*, in **2014**, I do not only solved the problem, but also enumerated *2-connected* and *3-connected self-dual maps*, showing that the later are counted by the **Fine numbers**. The *novel methods* introduced by us to study maps are likely to be applicable, e.g. in enumeration of *3-connected maps*, still an open problem.

In collaboration with *Ehrenborg* and *Perry*, in **2011**, I settled a **conjecture** of *Warlimont* on **asymptotics** for the number of permutations *avoiding a consecutive pattern*. In another paper, in **2015**, as a corollary to more general results, in collaboration with *Remmel*, I proved a **conjecture** of *Mather*, **3 conjectures** of *Hardin*, and a **conjecture** of *Baker*.

Gray codes, first applied in telegraphy in 1878, are an important listing method from theoretical and practical points of view. In **2016**, in collaboration with other researchers, I constructed Gray codes for **exhaustive generation of three classes of planar maps**. Planar maps are a natural model of discrete surfaces used, e.g. in *2D-quantum-gravity*. The results would not be possible without our **novel idea** on applying **description trees** in the context.

In **2015**, I proved a key result in the **theory of graphs representable by words and patterns**, establishing that **any binary pattern of length at least 3** can be used to represent **any graph**. The significance of this rather unexpected result is that w.r.t. **existence of representation point of view** there are **only two** interesting **non-equivalent cases**, one of which is the class of well-studied **word-representable graphs**.

As an *internationally recognised scientist*, in **2017**, I have been the **chair** of the organising committee of the **British Combinatorial Conference (BCC)**, probably the **world's most prestigious** general conference in Combinatorics.

Most significant publications over the last ten years

Some of my most significant papers in *chronological order* (authors are in *alphabetical order* on *all papers*) are as follows, where comments on the papers are provided:

1. Kitaev, Seif. Word problem of the Perkins semigroup via directed acyclic graphs, *Order* 25(**2008**)177-194. [See the comments above on the Perkin's semigroup.]
2. Bousquet-Melou, Claesson, Dukes, Kitaev. (2+2)-free posets, ascent sequences and pattern avoiding permutations, *J. Comb. Theory, Series A* 117 (**2010**) 7, 884-909. [See comments above on interval orders.]
3. Kitaev, Remmel. Enumerating (2+2)-free posets by the number of minimal elements and other statistics, *Discr. Appl. Math.* 159 (**2011**) 2098-2108. [The celebrated **interval orders** are enumerated according to **four statistics**, which is a highly non-trivial result. A *simple form* of a particular *important* case enumerated by us was conjectured. The conjecture was settled **independently** by **three researchers** using **different methods**.]
4. Ehrenborg, Kitaev, Perry. A spectral approach to consecutive pattern-avoiding permutations, *Journal of Combinatorics* 2 (**2011**) 305-353. [A **general method**, using the **spectral theory of integral operators** on $L^2([0,1]^m)$ is developed to find **asymptotics** for the number of permutations avoiding a set of **consecutive patterns**. *Kreuin* and *Rutman's* generalization of the *Perron-Frobenius theory* of non-negative matrices plays a central role. The method gives **detailed asymptotic expansions** and allows for **explicit computation** of leading terms in many cases.]
5. Kitaev, Mier, Noy. On the number of self-dual rooted maps, *European J. Combin.* 35 (**2014**) 377-387. [See the comments above on self-dual maps.]
6. Ehrenborg, Kitaev, Steingrimsson. Number of cycles in the graph of 312-avoiding permutations, *Journal of Combinatorial Theory – Series A* 129 (**2015**) 1-18. [The paper is named among **most downloaded articles** in the last 90 days in this journal, widely regarded as the **most prestigious journal** in combinatorics.]
7. Jones, Kitaev, Remmel. Frame patterns in n-cycles, *Discrete Mathematics* 338 (**2015**) 1197-1215. [A **novel idea** in the paper is to extend the study of **mesh patterns** from *permutations* to *cycles*. This links mesh patterns to a **host of various combinatorial objects**, most notably to **derangements** introduced in 1708.]
8. Halldorson, Kitaev, Pyatkin. Semi-transitive orientations and word-representable graphs, *Discrete Appl. Math.* 201 (**2016**) 164-171. [A **key tool** in the **theory of word-representable graphs**, called **semi-transitive orientations**, is introduced, which was *essential* in the development of the theory. The **majority** of papers on word-representable graphs use the tool.]
9. Avgustinovich, Kitaev, Potapov, Vajnovszki. Gray coding cubic planar maps. *Theoretical Comp. Science* 616 (**2016**) 59-69. [See the comments above on Gray codes.]
10. Gao, Kitaev, Zhang. Pattern-avoiding alternating words, *Discrete Appl. Math.* 339 (**2016**) 2079-2093. [The study of **alternating permutations**, counted by **Euler numbers** and occurring in many places in mathematics, goes back to 1879, and it still attracts much attention in the literature. However, no one managed to define the notion of an **alternating word**, a natural extension from permutations to words. The paper not only closes that gap by defining and enumerating alternating words, but also enumerates classes of alternating words avoiding *patterns of length 3* that gives links to the **Narayana** and **Fibonacci numbers**.]