Curriculum Vitae

Valery A. Gaiko

1 Personal data

- **Nationality** — Belarus
- **Date of birth** — March 31, 1960 (male)
- **Place of birth** — Stolbtsy, Minsk region, Belarus
- **Mailing address** — Leonid Beda Str. 6-4, Minsk 220040, Belarus
- **Tel., E-mail** — +375-29-7646662, valery.gaiko@gmail.com
- **URL** — http://uiip.bas-net.by/eng/personal/gaiko.php

2 Working experience

2.1 Present position

- **Leading Researcher** — Interdisciplinary Research Group, United Institute of Informatics Problems, National Academy of Sciences of Belarus, Minsk, Belarus (June 2009 – present)

2.2 Previous positions

- **Research Fellow** — China–Russia Mathematics Center, School of Mathematics, Sichuan University, Chengdu, China (May – June 2023)
- **Associate Professor** — Higher School of Mechanics and Control Processes, Institute of Physics and Mechanics, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia (September – December 2022)
- **Research Fellow** — Department of Mathematics, Technische Universität Dresden, Dresden, Germany (September – October 2020)
- **Research Fellow** — Center for Technologies in Robotics and Mechatronics Components, Innopolis University, Innopolis, Russia (January – May 2020)
- **Research Fellow** — Department of Dynamical Systems, University of Groningen, Groningen, The Netherlands (July – October 2019)

- **Research Fellow** — Mathematics Institute, University of Warwick, Coventry, UK (February – March 2019)
- **Research Fellow** — Delft Institute of Applied Mathematics, Delft University of Technology, Delft, The Netherlands (July – October 2018)
- **Research Fellow** — Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France (April – May 2018)
- **Research Fellow** — Department of Mathematics, Technische Universität Dresden, Dresden, Germany (September – November 2016)
- **Research Fellow** — Department of Dynamical Systems, University of Groningen, Groningen, The Netherlands (September – December 2015)
- **Research Fellow** — Department of Mathematics and Statistics, Missouri University of Science and Technology, USA (March – April 2015)
- **Research Fellow** — Institut für Mathematik, Technische Universität Ilmenau, Ilmenau, Germany (September – October 2012)
- **Research Fellow** — Department of Dynamical Systems, University of Groningen, Groningen, The Netherlands (September 2011 – February 2012)
- **Research Fellow** — Max Plank Institute for Mathematics, Bonn, Germany (March – April 2011)
- **Research Fellow** — Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France (July – August 2009)
- **Associate Professor** — Department of Mathematics, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus (September 1999 – May 2009)
- **Research Fellow** — Department of Dynamical Systems, University of Groningen, Groningen, The Netherlands (September 2008 – February 2009)
- **Research Fellow** — Delft Institute of Applied Mathematics, Delft University of Technology, Delft, The Netherlands (October 2007 – March 2008)
- **Visiting Professor** — Department of Mathematical Sciences, The University of Memphis, Memphis, USA (January – May 2005)
- **Research Fellow** — Delft Institute of Applied Mathematics, Delft University of Technology, Delft, The Netherlands (July – December 2003)
- **Research Fellow** — Institut für Mathematik, Technische Universität Ilmenau, Ilmenau, Germany (January – March 1997)
- **Postdoctoral Researcher** — Department of Mathematics, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus (September 1996 – August 1999)

- **Associate Professor** — Department of Mathematics, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus (November 1992 – August 1996)

- **Assistant Professor** — Department of Mathematics, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus (February 1986 – October 1992)

2.3 Obligatory references

- **Professor Martin Bohner** — Department of Mathematics and Statistics, Missouri University of Science and Technology, 106 Rolla Building, Rolla, Missouri 65409-0020, USA, Tel.: +1-573-3414129, E-mail: bohner@mst.edu

- **Professor Fernanda Botelho** — Department of Mathematical Sciences, The University of Memphis, 373 Dunn Hall, Memphis, Tennessee 38152-3420, USA, Tel.: +1-901-6782482, E-mail: mbotelho@memphis.edu

- **Professor John Graef** — Department of Mathematics, University of Tennessee at Chattanooga, 615 McCallie Avenue, Chattanooga, Tennessee 37403-2598, USA, Tel.: +1-423-7554545, E-mail: john-graef@utc.edu

- **Professor Nikolay A. Lukashevich** — Postdoctoral Adviser

- **Academician Nikolay P. Erugin** — Postgraduate Supervisor

2.4 Other references

- **Professor Stefan Siegmund** — Department of Mathematics, Technische Universität Dresden, Helmholtzstrasse 10, 01062 Dresden, Germany, Tel.:+49-351-46334633, E-mail: stefan.siegmund@tu-dresden.de

- **Professor Wim T. van Horssen** — Delft Institute of Applied Mathematics, Delft University of Technology, Van Mourik Broekmanweg 6, 2628 XE Delft, The Netherlands, Tel.: +31-15-2783524, E-mail: W.T.vanHorssen@tudelft.nl

3 Education and training

3.1 Degrees and evaluation of qualifications

- **Associate Professor (1994)** — Department of Mathematics, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus (Diploma of Docent)

- **Ph. D. (1993)** — Belarusian State University, Minsk, Belarus, thesis title: "Limit Cycle Bifurcations of Quadratic Autonomous Systems in the Plane", supervisor: N. P. Erugin (Diploma of Candidate of Physical and Mathematical Sciences)

- **M. Sc. (1982)** — Faculty of Mechanics and Mathematics, Belarusian State University, Minsk, Belarus (Honours Diploma of Mathematician)

3.2 Other education

- **Ph. D. Student** — Institute of Mathematics, National Academy of Sciences of Belarus, Minsk, Belarus (November 1982 – January 1986)

3.3 Language skills

- **Russian** — native language
- **Belarusian** — native language
- **English** — fluent (two-year course, Minsk Linguistic University, 1994 – 1995)
- **French** — good (two-year course, Minsk Linguistic University, 1996 – 1997)
- **German** — basic (two-month intensive course, Belarusian State University of Informatics and Radioelectronics, 1998)

4 Scientific qualifications

4.1 List of publications

4.1.1 Monographs and collections of scientific works

1. V. A. Gaiko, *Global Bifurcations of Limit Cycles and Hilbert's Sixteenth Problem*, Minsk: Universitetskoe Publishers, 2000, 167 p. (Russian).
2. V. A. Gaiko, *Global Bifurcation Theory and Hilbert's Sixteenth Problem*, Boston: Kluwer Academic Publishers, 2003, 204 p.
3. A. K. Abramyan, I. V. Andrianov, V. A. Gaiko (Eds), *Nonlinear Dynamics of Discrete and Continuous Systems*, Basel: Springer Nature, 2020, 277 p.
4. V. A. Gaiko, Global bifurcation analysis of polynomial dynamical systems, in *Nonlinear Dynamics of Discrete and Continuous Systems*, A. K. Abramyan, I. V. Andrianov, V. A. Gaiko, Eds, Basel: Springer Nature, 2020, Ch. 6, pp. 83–101.

4.1.2 Articles published in scientific journals

1. L. A. Cherkas and V. A. Gaiko, Bifurcations of limit cycles of a quadratic system with two field-rotation parameters, *Doklady of Academy of Sciences of Belarus* **29** (1985), no. 8, 694–696 (Russian).
2. L. A. Cherkas and V. A. Gaiko, Bifurcations of limit cycles of a quadratic system with two critical points and two field-rotation parameters, *Differentsial'nye Uravneniya* **23** (1987), no. 9, 1544–1553 (Russian); *Differential Equations* **23** (1987), no. 9, 1062–1069.
3. V. A. Gaiko, Separatrix cycles of quadratic systems, *Doklady of Academy of Sciences of Belarus* **37** (1993), no. 3, 18–21 (Russian).

4. V. A. Gaiko, On application of two isoclines method to investigation of two-dimensional dynamical systems, *Advances of Synergetics* **2** (1994), 104–109.

5. V. A. Gaiko, Bifurcations of limit cycles and classification of separatrix cycles of two-dimensional polynomial dynamical systems, *Vestnik of Belarusian State University, Series 1* (1995), no. 2, 69–70 (Russian).

6. V. A. Gaiko, Geometric approaches to qualitative investigation of polynomial systems, *Advances of Synergetics* **6** (1996), 176–180.

7. V. A. Gaiko, On development of new approaches to investigation of limit cycle bifurcations, *Advances of Synergetics* **8** (1997), 162–164.

8. V. A. Gaiko, Qualitative theory of two-dimensional polynomial dynamical systems: problems, approaches, conjectures, *Nonlinear Analysis* **30** (1997), no. 3, 1385–1394.

9. V. A. Gaiko, On application of topological methods to qualitative investigation of two-dimensional polynomial dynamical systems, *Universitatis Iagellonicae Acta Mathematica* **36** (1998), 211–213.

10. V. A. Gaiko, Global qualitative investigation of a generalized Lotka–Volterra model, *Mathematics. Computer. Education* **6** (1999), no. 2, 249–256 (Russian).

11. V. A. Gaiko, Global bifurcations in polynomial dynamical systems, *Mathematical Research* **5** (1999), 19–25.

12. V. A. Gaiko, Global bifurcations of limit cycles, *Differential Equations and Control Processes* **3** (2000), 1–15.

13. V. A. Gaiko, On global bifurcations and Hilbert's sixteenth problem, *Nonlinear Phenomena in Complex Systems* **3** (2000), no. 1, 11–27.

14. V. A. Gaiko, Hilbert's sixteenth problem and global bifurcations of limit cycles, *Nonlinear Analysis* **47** (2001), no. 7, 4455–4466.

15. V. A. Gaiko, Geometric methods of qualitative analysis and global bifurcation theory, *Nonlinear Phenomena in Complex Systems* **5** (2002), no. 1, 1–20.

16. V. A. Gaiko, On a work by N.P.Erugin, *Mathematics. Computer. Education* **9** (2002), no. 2, 482–490 (Russian).

17. V. A. Gaiko, On the Andronov–Hopf bifurcation, *Nonlinear Phenomena in Complex Systems* **5** (2002), no. 2, 137–150.

18. V. A. Gaiko, Abelian integrals and limit cycles in polynomial dynamical systems, *Nonlinear Phenomena in Complex Systems* **6** (2003), no. 1, 577–581.

19. V. A. Gaiko, Geometric interpretation of quadratic centers, *Nonlinear Oscillations* **6** (2003), no. 1, 21–33.

20. V. A. Gaiko, Global bifurcation families of multiple limit cycles in polynomial dynamical systems, *Nonlinear Phenomena in Complex Systems* **6** (2003), no. 3, 734–745.

21. V. A. Gaiko, Termination principle by Wintner–Perko, field-rotation parameters, and limit-cycle problem, *Contemporary Mathematics and Its Applications* **7** (2003), 35–42 (Russian).

22. V. A. Gaiko and W. T. van Horssen, Global bifurcations of limit and separatrix cycles in a generalized Liénard system, *Nonlinear Analysis* **59** (2004), no. 1–2, 189–198.

23. V. A. Gaiko, Wintner–Perko termination principle, parameters rotating a field, and limit-cycle problem, *Journal of Mathematical Sciences* **126** (2005), no. 4, 1259–1266.

24. V. A. Gaiko and F. Botelho, Dynamical systems: bifurcations and applications, *Problems of Nonlinear Analysis in Engineering Systems* **11** (2005), no. 1, 100–107.

25. F. Botelho and V. A. Gaiko, Global analysis of planar neural networks, *Nonlinear Analysis* **64** (2006), no. 1, 1002–1011.

26. V. A. Gaiko, Global bifurcations of limit cycles, *International Journal: Mathematical Manuscripts* **1** (2007), no. 2, 206–224.

27. V. A. Gaiko, Limit cycles of quadratic systems, *Nonlinear Analysis* **69** (2008), no. 7, 2150–2157.

28. V. A. Gaiko, Limit cycles of polynomial Liénard's system, *Dynamic Systems and Applications* **5** (2008), 21–28.

29. V. A. Gaiko, Towards the geometry of polynomial dynamical systems, *Contemporary Mathematics and Its Applications* **53** (2008), 15–28 (Russian).

30. V. A. Gaiko, Limit cycles of Liénard-type dynamical systems, *CUBO: A Mathematical Journal* **10** (2008), no. 3, 115–132.

31. F. Botelho and V. A. Gaiko, Qualitative theory and applications of dynamical systems, *Problems of Nonlinear Analysis in Engineering Systems* **30** (2008), no. 2, 1–6.

32. V. A. Gaiko, On the geometry of polynomial dynamical systems, *Journal of Mathematical Sciences* **157** (2009), no. 3, 400–412.

33. V. A. Gaiko and W. T. van Horssen, A piecewise linear dynamical system with two dropping sections, *International Journal of Bifurcation and Chaos* **19** (2009), no. 4, 1367–1372.

34. V. A. Gaiko and W. T. van Horssen, Global analysis of a piecewise linear Liénard-type dynamical system, *International Journal of Dynamical Systems and Differential Equations* **2** (2009), no. 1–2, 115–128.

35. V. A. Gaiko, A quadratic system with two parallel straight-line-isoclines, *Nonlinear Analysis* **71** (2009), no. 11, 5860–5865.

36. H. W. Broer and V. A. Gaiko, Global qualitative analysis of a quartic ecological model, *Nonlinear Analysis* **72** (2010), no. 2, 628–634.

37. V. A. Gaiko, Global bifurcation analysis of a quartic predator-prey model, *Computer Research and Modeling* **3** (2011), no. 2, 125–134 (Russian).

38. V. A. Gaiko, The geometry of limit cycle bifurcations in polynomial dynamical systems, *Discrete and Continuous Dynamical Systems Supplement* **5** (2011), 447–456.

39. V. A. Gaiko, Multiple limit cycle bifurcations of the FitzHugh–Nagumo neuronal model, *Nonlinear Analysis* **74** (2011), no. 18, 7532–7542.

40. V. A. Gaiko, On limit cycles surrounding a singular point, *Differential Equations and Dynamical Systems* **20** (2012), no. 2, 329–337.

41. V. A. Gaiko, The applied geometry of a general Liénard polynomial system, *Applied Mathematics Letters* **25** (2012), no. 12, 2327–2331.

42. V. A. Gaiko, Limit cycle bifurcations of a general Liénard system with polynomial restoring and damping functions, *International Journal of Dynamical Systems and Differential Equations* **4** (2012), no. 3, 242–254.

43. V. A. Gaiko, Limit cycle bifurcations of a Liénard system with cubic restoring and polynomial damping functions, *Scientific Herald of Chernivtsi National University. Series: Mathematics* **2** (2012), no. 2–3, 30–35.

44. V. A. Gaiko, Chaos transition in the Lorenz system, *Herald of Odesa National University. Mathematics and Mechanics* **18** (2013), no. 2, 51–58.

45. V. A. Gaiko, Limit cycle bifurcations of a special Liénard polynomial system, *Advances in Dynamical Systems and Applications* **9** (2014), no. 1, 109–123.

46. V. A. Gaiko, Global bifurcation analysis of the Lorenz system, *Journal of Nonlinear Science and Applications* **7** (2014), no. 6, 429–434.

47. V. A. Gaiko, Maximum number and distribution of limit cycles in the general Liénard polynomial system, *Advances in Dynamical Systems and Applications* **10** (2015), no. 2, 177–188.

48. V. A. Gaiko, Global qualitative analysis of a Holling-type system, *International Journal of Dynamical Systems and Differential Equations* **6** (2016), no. 2, 161–172.

49. V. A. Gaiko, Global bifurcation analysis of a rational Holling system, *Computer Research and Modeling* **9** (2017), no. 4, 537–545 (Russian).

50. V. A. Gaiko, J.-M. Ginoux and C. Vuik, The termination principle of multiple limit cycles for the Kukles cubic system, *Cybernetics and Physics* **6** (2017), no. 4, 195–200.

51. V. A. Gaiko, Global bifurcation analysis of the Kukles cubic system, *International Journal of Dynamical Systems and Differential Equations* **8** (2018), no. 4, 326–336.

52. V. A. Gaiko, Global limit cycle bifurcations of the cubic-linear dynamical system, *Functional Differential Equations* **25** (2018), no. 3–4, 127–141.

53. V. A. Gaiko and C. Vuik, Global dynamics in the Leslie–Gower model with the Allee effect, *International Journal of Bifurcation and Chaos* **28** (2018), no. 12, 1850151, 10 p.

54. V. A. Gaiko and C. Vuik, Multi-parameter planar dynamical systems: global bifurcations of limit cycles, *Dynamical Systems* **8** (2018), no. 1, 73–88.

55. V. A. Gaiko, C. Vuik and H. Reijm, Bifurcation analysis of a multi-parameter Liénard polynomial system, *IFAC-PapersOnLine* **51** (2018), no. 33, 144–149.

56. V. A. Gaiko, H. W. Broer and A. E. Sterk, Global bifurcation analysis of Topp system, *Cybernetics and Physics* **8** (2019), no. 4, 244–250.

57. V. A. Gaiko, Global bifurcations of limit cycles in an endocrine system model, *Advances in Dynamical Systems and Applications* **15** (2020), no. 1, 15–25.

58. V. A. Gaiko, S. I. Savin, A. S. Klimchik, Global limit cycle bifurcations of a polynomial Euler–Lagrange–Liénard system, *Computer Research and Modeling* **12** (2020), no. 4, 693–705 (Russian).

59. V. A. Gaiko, Global limit cycle bifurcations of multi-parameter polynomial dynamical systems, *Ukrainian Mathematical Bulletin* **18** (2021), no. 4, 518–539.

60. V. A. Gaiko, Limit cycles of multi-parameter polynomial dynamical systems, *Journal of Mathematical Sciences* **260** (2022), no. 5, 662–677.

61. V. A. Gaiko, Global limit cycle bifurcations of a generalized Liénard polynomial dynamical system, *Problems in Mathematical Analysis* **123** (2023), 49–56.

62. V. A. Gaiko, Global bifurcation analysis of generalized Liénard polynomial dynamical system, *Journal of Mathematical Sciences* **270** (2023), no. 5, 674–682.

5 Special volumes

1. V. A. Gaiko and L. A. Cherkas, Bifurcations of limit cycles of vector fields on C^2 and R^2. In: *Problems of Qualitative Theory of Differential Equations*, V. M. Matrosov and L. Yu. Anapolsky, Eds, Novosibirsk: Nauka, 1988, pp. 17–22 (Russian).

2. V. A. Gaiko, Limit cycle bifurcations. In: *Differential Equations*, Vol. 1, B. Fiedler et al., Eds, New Jersey: World Scientific, 2000, pp. 100–102.

3. V. A. Gaiko, On global bifurcation theory of polynomial dynamical systems and its applications. In: *Communications in Difference Equations*, S. Elaydi et al., Eds, Amsterdam: Gordon and Breach Science Publishers, 2000, pp. 135–148.

4. V. A. Gaiko, Classification of separatrix cycles and a global approach to Hilbert's sixteenth problem. In: *Progress in Nonlinear Science*, Vol. 1, L. M. Lerman and L. P. Shil'nikov, Eds, Nizhny Novgorod: University of Nizhny Novgorod Publishers, 2002, pp. 235–240.

5. V. A. Gaiko, Limit cycle bifurcations in polynomial models of dynamical systems. In: *Progress in Analysis*, Vol. 1, H. Begehr et al., Eds, New Jersey: World Scientific, 2003, pp. 525–534.

6. V. A. Gaiko, Global bifurcations and chaos in polynomial dynamical systems. In: *Physics and Control*, Vol. 2, A. L. Fradkov and A. N. Churilov, Eds, St. Petersburg: RAS Publishers, 2003, pp. 670–674.

7. V. A. Gaiko and W. T. van Horssen, Global analysis of a canonical cubic system. In: *Equadiff 2003*, F. Dumortier et al., Eds, New Jersey: World Scientific, 2005, pp. 1071–1073.

8. V. A. Gaiko, Global limit cycle bifurcations in a biomedical model. In: *Progress in Analysis and Its Applications*, M. Ruzhansky and J. Wirth, Eds, New Jersey: World Scientific, 2010, pp. 537–543.

9. V. A. Gaiko, On the classical Lorenz system. In: *Current Trends in Analysis and Its Applications*, V. V. Mityushev and M. V. Ruzhansky, Eds, Basel: Birkhäser, 2015, pp. 655–661.

10. V. A. Gaiko, A. E. Sterk and H. W. Broer, Bifurcation analysis of the Topp model. In: *Current Trends in Analysis, its Applications and Computation*, P. Cerejeiras et al., Eds, Cham: Birkhäser, 2022, pp. 3–9.

5.0.1 Conferences and symposiums

1. L. A. Cherkas and V. A. Gaiko, Limit cycles of quadratic systems with two field-rotation parameters, in *Proceedings of the First Conference on Differential Equations and Applications*, April 1983, Grodno, Belarus, pp. 175–177 (Russian).

2. V. A. Gaiko, The limit cycle bifurcations of quadratic autonomous systems, in *Nonlinear Phenomena in Complex Systems*, V. I. Kuvshinov and D. W. Serow, Eds, St. Petersburg: Institute of Physics Publishers, 1993, pp. 60–65.

3. V. A. Gaiko, Complete classification of separatrix cycles in quadratic systems, in *Proceedings of the Conference on Actual Problems of Informatics*, May 1994, Minsk, Belarus, pp. 281–282 (Russian).

4. V. A. Gaiko, Qualitative investigation, limit cycle bifurcations and applications of polynomial dynamical systems, in *Differential Equations and Their Applications*, Z. Došlá et al., Eds, Brno: Masaryk University Publishers, 1997, pp. 123–130.

5. V. A. Gaiko, Control of multiple limit cycles, in *Nonlinear Phenomena in Complex Systems*, L. Babichev and V. Kuvshinov, Eds, Minsk: Institute of Physics Publishers, 1998, pp. 53–57.

6. V. A. Gaiko, On global bifurcation theory of polynomial dynamical systems, in *Proceedings of the Fourth International Conference on Difference Equations and Applications*, J. Popenda et al., Eds, Poznań: Wydawnictwo Politechniki Poznanskiej, 1998, pp. 113–114.

7. V. A. Gaiko, Termination principle and global analysis of polynomial dynamical systems, in *Nonlinear Phenomena in Complex Systems*, L. Babichev and V. Kuvshinov, Eds, Minsk: Institute of Physics Publishers, 1999, pp. 255–263.

8. V. A. Gaiko, A global approach to Hilbert's sixteenth problem, in *Nonlinear Phenomena in Complex Systems*, L. Babichev and V. Kuvshinov, Eds, Minsk: Institute of Physics Publishers, 2000, pp. 310–312.

9. V. A. Gaiko, On global bifurcation theory of polynomial dynamical systems, *Proceedings of National Academy of Sciences of Belarus, Physics and Mathematics Series*, no. 4 (2000), p. 134 (Russian).

10. V. A. Gaiko, On Abelian integrals and limit cycles, in *Nonlinear Phenomena in Complex Systems*, L. Babichev and V. Kuvshinov, Eds, Minsk: Institute of Physics Publishers, 2002, pp. 79–84.

11. V. A. Gaiko, Two approaches to Hilbert's sixteenth problem, in *Proceedings of the International Conference on Differential Equations and Dynamical Systems*, July 2002, Suzdal, Russia, E. F. Mishchenko et al., Eds, Moscow: V. A. Steklov Mathematical Institute of Russian Academy of Sciences, 2002, pp. 168–170.

12. V. A. Gaiko, Global qualitative analysis of a generalized Liénard system, in *Proceedings of the International Conference on Differential Equations and Dynamical Systems*, July 2004, Suzdal, Russia, E. F. Mishchenko et al., Eds, Moscow: V. A. Steklov Mathematical Institute of Russian Academy of Sciences, 2004, pp. 254–256.

13. V. A. Gaiko, Bifurcations and applications of planar dynamical systems, in *Proceedings of the International Conference on Differential Equations and Dynamical Systems*, July 2006, Suzdal, Russia, E. F. Mishchenko et al., Eds, Moscow: V. A. Steklov Mathematical Institute of Russian Academy of Sciences, 2006, pp. 250–252.

14. V. A. Gaiko, On limit cycle bifurcations of a piecewise linear Liénard-type dynamical system, in *Proceedings of the International Conference on Differential Equations and Dynamical Systems*, June 2008, Suzdal, Russia, E. F. Mishchenko et al., Eds, Moscow: V. A. Steklov Mathematical Institute of Russian Academy of Sciences, 2008, pp. 288–290.

15. V. A. Gaiko and W. T. van Horssen, Limit cycle bifurcations of a piecewise linear dynamical system, *Proceedings of the 6th EUROMECH Nonlinear Oscillations Conference (ENOC 2008)*, July 2008, Saint Petersburg, Russia, pp. 1559–1564.

16. V. A. Gaiko, H. W. Broer and W. T. van Horssen, Limit cycles of a population dynamics model, *Proceedings of 4th International Scientific Conference on Physics and Control (PHYSCON 2009)*, September 2009, Catania, Italy, pp. 1922–1925.

17. V. A. Gaiko, Attractors of the FitzHugh–Nagumo neuronal model, *Proceedings of the 2nd International Symposium on Rare Attractors and Rare Phenomena in Nonlinear Dynamics (RA'11)*, May 2011, Riga, Latvia, pp. 89–92.

18. V. A. Gaiko, Limit cycle bifurcations of the classical Liénard polynomial system, *Proceedings of the 5th International Scientific Conference on Physics and Control (PHYSCON 2011)*, September 2011, León, Spain, pp. 2241–2244.

19. V. A. Gaiko, Limit cycles of the general Liénard polynomial system, *Proceedings of 4the International Conference on Dynamics, Topology and Computation (DyToComp 2012)*, June 2012, Kraków, Poland, http://www.ii.uj.edu.pl /DyToComp2012/program.pdf, 25 p.

20. V. A. Gaiko, Limit cycle bifurcations of the general Liénard polynomial system, *Proceedings of the Sixth European Congress of Mathematics (6ECM)*, July 2012, Kraków, Poland, http://www.6ecm.pl/en/programme/posters, 17 p.

21. V. A. Gaiko, Control of limit cycle bifurcations in general Liénard's polynomial system, *Proceedings of the 6th International Scientific Conference on Physics and Control (PHYSCON 2013)*, August 2013, San Luis Potosí, México, pp. 2651–2656.

22. V. A. Gaiko, The classical and general Liénard polynomial systems: global bifurcations of limit cycles, *Proceedings of the 8th International Symposium on Classical and Celestial Mechanics*, September 2013, Siedlce, Poland, pp. 21–22.

23. V. A. Gaiko and N. V. Gaiko, Limit cycle bifurcations in polynomial Liénard and Lorenz dynamical systems, *Proceedings of The 8th European Nonlinear Oscillations Conferences (ENOC 2014)*, July 2014, Vienna, Austria, http://enoc2014.conf. tuwien.ac.at/Proceedings/full-papers/185.pdf, 6 p.

24. V. A. Gaiko, A bifurcation scenario of chaos transition for the classical Lorenz system, *Proceedings of the 3rd Conference of Mathematical Society of the Republic of Moldova*, August 2014, Chişinău, Moldova, pp. 195–198.

25. V. A. Gaiko, Global bifurcations in low-dimensional dynamical systems, *Proceedings of the International Conference on Patterns of Dynamics*, July 2016, Berlin, Germany, https://conference.imp.fu-berlin.de/patterns-of-dynamics/download/Valery Gaiko.pdf, 39 p.

26. V. A. Gaiko, Global bifurcation analysis of low-dimensional polynomial dynamical systems, *Proceedings of the 11th International School on Chaotic Oscillations and Pattern Formation*, October 2016, Saratov, Russia, pp. 142–143.

27. V. A. Gaiko, Towards global bifurcation theory of polynomial dynamical systems, *Proceedings of the International Conference on Dynamics in Siberia*, February 2017, Novosibirsk, Russia, http://www.math.nsc.ru/conference/ds/2017/talks/talk-by-Gaiko.pdf, 44 p.

28. V. A. Gaiko, On the Kukles cubic system, *Proceedings of the Ninth European Nonlinear Dynamics Conference (ENOC 2017)*, June 2017, Budapest, Hungary, http://enoc2017-abstract.congressline.hu, 2 p.

29. V. A. Gaiko, J.-M. Ginoux and C. Vuik, Control of limit cycle bifurcations in the Kukles cubic system, *Proceedings of the 8th International Scientific Conference on Physics and Control (PHYSCON 2017)*, July 2017, Florence, Italy, IPACS Electronic Library, pp. 1–6.

30. V. A. Gaiko, Limit cycles of the Kukles cubic system, *Proceedings of the International Conference on Mathematical Modelling in Applied Sciences (ICMMAS 2017)*, July 2017, Saint Petersburg, Russia, pp. 116–117.

31. V. A. Gaiko, Limit cycles of a Topp system, *Proceedings of the 9th International Scientific Conference on Physics and Control (PHYSCON 2019)*, September 2019, Innopolis, Russia, pp. 96–99.

32. V. A. Gaiko, Global limit cycle bifurcations of a rational Kolmogorov type system, *Proceedings of the IV Scientific School on Dynamics of Complex Networks and Their Application in Intellectual Robotics (DCNAIR 2020)*, September 2020, Innopolis, Russia, IEEE Xplore Digital Library, https://ieeexplore.ieee.org/xpl/conhome/9211389/proceeding, pp. 88–91.

33. V. A. Gaiko, Global dynamics and limit cycle bifurcations of a planar polynomial mechanical system, *Proceedings of the 10th International Scientific Conference on Physics and Control (PHYSCON 2021)*, October 2021, Shanghai, China, IPACS Electronic Library, pp. 1–6.

34. V. A. Gaiko, Multistability and limit cycles in polynomial dynamical systems, *Proceedings of the International Conference on Differential Equations and Optimal Control*, June 2022, Moscow, Russia, pp. 42–44.

35. V. A. Gaiko, Catastrophe theory and global bifurcations of limit cycles, *Proceedings of the Seventh International Conference on Nonlinear Analysis and Extremal Problems*, July 2022, Irkutsk, Russia, pp. 38–39.

5.0.2 Other publications

1. V. A. Gaiko, Limit cycle bifurcations of quadratic autonomous systems in the plane, *Ph. D. Theses*, Belarusian State University, Minsk, 1993, 100 p.

2. V. I. Bernik, V. A. Gaiko et al., *Mathematical Encyclopedia*, Minsk: Technology, 2001, 496 p. (Belarusian).

3. V. A. Gaiko and W. T. van Horssen, Global bifurcations in a generalized Liénard system, *Report 03-17*, Delft University of Technology, Delft (Netherlands), 2003, 15 p.

4. V. A. Gaiko, Geometry of planar quadratic systems, *arXiv:math.DS/0611142*, 2006, 13 p.

5. V. A. Gaiko, Liénard's system and Smale's problem, *arXiv:math.DS/0611143*, 2006, 15 p.

6. V. A. Gaiko, Field rotation parameters and limit cycle bifurcations, *Preprint M/06/54*, Institut des Hautes Études Scientifiques, Bures-sur-Yvette (France), 2006, 26 p.

7. V. A. Gaiko and W. T. van Horssen, Global analysis of piecewise linear dynamical systems, *Report 07-16*, Delft University of Technology, Delft (Netherlands), 2007, 15 p.

8. V. A. Gaiko and W. T. van Horssen, Towards theory of piecewise linear dynamical systems, *arXiv:math.DS/08030490*, 2008, 15 p.

9. V. A. Gaiko, Limit cycles of a quadratic system with two parallel straight line-isoclines, *arXiv:math.DS/08033055*, 2008, 10 p.
10. V. A. Gaiko, Limit cycle bifurcations in a quadratic system with two parallel straight line-isoclines, *Report 08-06*, Delft University of Technology, Delft (Netherlands), 2008, 10 p.
11. H. W. Broer and V. A. Gaiko, Limit cycle bifurcations in a quartic ecological model, *arXiv:math.DS/09022433*, 2009, 13 p.
12. V. A. Gaiko, Global bifurcations of multiple limit cycles in the FitzHugh–Nagumo system, *arXiv:math.DS/11043019*, 2011, 22 p.
13. V. A. Gaiko, Towards theory of neural dynamical systems, *Preprint 2011-23*, Max-Planck-Institut für Mathematik, Bonn (Germany), 2011, 24 p.
14. V. A. Gaiko, The general Liénard polynomial system, *arXiv:math.DS/12023540*, 2012, 17 p.
15. V. A. Gaiko, A bifurcational geometric approach to the problem of chaos transition in the classical Lorenz system, *arXiv:math.DS/13078315*, 2013, 10 p.
16. V. A. Gaiko, Global bifurcations of limit cycles in a Holling-type dynamical system, *arXiv:math.DS/150403353*, 2015, 19 p.
17. V. A. Gaiko, Global bifurcations of limit cycles in the Kukles cubic system, *arXiv: math.DS/161108113*, 2016, 14 p.
18. V. A. Gaiko, C. Vuik, Multi-parameter planar polynomial dynamical systems, *Preprint M/18/05*, Institut des Hautes Études Scientifiques, Bures-sur-Yvette (France), 2018, 19 p.
19. V. A. Gaiko, J.-M. Ginoux, C. Vuik, Global bifurcations of limit cycles in the Leslie–Gower model with the Allee effect, *Preprint M/18/06*, Institut des Hautes Études Scientifiques, Bures-sur-Yvette (France), 2018, 16 p.
20. V. A. Gaiko, Limit cycle bifurcations of a reduced Topp system, *arXiv:q-bio.QM /1904.05311*, 2019, 14 p.

5.1 Selection of scientific publications

1. V. A. Gaiko, Hilbert's sixteenth problem and global bifurcations of limit cycles, *Nonlinear Analysis* **47** (2001), no. 7, 4455–4466 (ISSN: 0362-546X).

   In this paper, we consider polynomial dynamical systems. We develop Erugin's two-isocline method for the global analysis of such systems, construct canonical systems with field rotation parameters and study various limit cycle bifurcations in the quadratic case of polynomial systems. In particular, we present a classification of separatrix cycles and consider the bifurcation of multiple limit cycles. Using the canonical systems, cyclicity results and Wintner–Perko termination principle, we suggest a global approach to solving Hilbert's Sixteenth Problem.

2. F. Botelho and V. A. Gaiko, Global analysis of planar neural networks, *Nonlinear Analysis* **64** (2006), no. 1, 1002–1011 (ISSN: 0362-546X).

   In this paper, the global qualitative analysis of cubic dynamical systems is established. These systems are used as learning models of planar neural networks (V. A. Gaiko: participation in constructing the learning model of planar neural networks; studying the limit cycle bifurcations; obtaining the main results).

3. V. A. Gaiko, Limit cycles of quadratic systems, *Nonlinear Analysis* **69** (2008), no. 7, 2150–2157 (ISSN: 0362-546X).

   In this paper, the global qualitative analysis of planar quadratic dynamical systems is established and a new geometric approach to solving Hilbert's Sixteenth Problem in this special case of polynomial systems is suggested. Using geometric properties of four field rotation parameters of a new canonical system which is constructed in this paper, we present a proof of our earlier conjecture that the maximum number of limit cycles in a quadratic system is equal to four and their only possible distribution is (3 : 1) (see: V. A. Gaiko, *Global Bifurcation Theory and Hilbert's Sixteenth Problem*, Boston: Kluwer Academic Publishers, 2003). Besides, applying the Wintner–Perko termination principle for multiple limit cycles to our canonical system, we prove in a different way that a quadratic system has at most three limit cycles around a singular point (focus) and give another proof of the same conjecture.

4. V. A. Gaiko and W.T. van Horssen, Global analysis of a piecewise linear Liénard-type dynamical system, *International Journal of Dynamical Systems and Differential Equations* **2** (2009), no. 1–2, 115–128 (ISSN: 1752-3583)

   In this paper, we consider a planar dynamical system with a piecewise linear function containing an arbitrary number of dropping sections and approximating some continuous nonlinear function. Studying all possible local and global bifurcations of its limit cycles, we prove that such a piecewise linear dynamical system with k dropping sections and $2k+1$ singular points can have at most $k+2$ limit cycles, $k+1$ of which surround the foci one by one and the last, $(k+2)$-th, limit cycle surrounds all of the singular points of this system (V. A. Gaiko: participation in formulating the problem; studying the limit cycle bifurcations; obtaining the main results).

5. H. W. Broer and V. A. Gaiko, Global qualitative analysis of a quartic ecological model, *Nonlinear Analysis* **72** (2010), no. 2, 628–634 (ISSN: 0362-546X).

   In this paper, we complete the global qualitative analysis of a quartic ecological model. In particular, studying global bifurcations of singular points and limit cycles, we prove that the corresponding dynamical system has at most two limit cycles (V. A. Gaiko: participation in formulating the problem; studying the global bifurcations of singular points and limit cycles; obtaining the main results).

6. V. A. Gaiko, Multiple limit cycle bifurcations of the FitzHugh–Nagumo neuronal model, *Nonlinear Analysis* **74** (2011), no. 18, 7532–7542 (ISSN: 0362-546X).

   We complete the global qualitative analysis of the well-known FitzHugh–Nagumo neuronal model. In particular, studying global limit cycle bifurcations and applying the Wintner–Perko termination principle for multiple limit cycles, we prove that the corresponding dynamical system has at most two limit cycles.

7. V. A. Gaiko, The applied geometry of a general Liénard polynomial system, *Applied Mathematics Letters* **25** (2012), no. 12, 2327–2331 (ISSN: 0893-9659).

   In this paper, applying a canonical system with field rotation parameters and using geometric properties of the spirals filling the interior and exterior domains of limit cycles, we solve the limit cycle problem for a general Liénard polynomial system with an arbitrary (but finite) number of singular points.

8. V. A. Gaiko, Global bifurcation analysis of the Lorenz system, *Journal of Nonlinear Science and Applications* **7** (2014), no. 6, 429–434 (ISSN: 2008-1898).

   We carry out the global bifurcation analysis of the classical Lorenz system. For many years, this system has been the subject of study by numerous authors. However, until now the structure of the Lorenz attractor is not clear completely yet, and the most important question at present is to understand the bifurcation scenario of chaos transition in this system. Using some numerical results and our bifurcational geometric approach, we present a new scenario of chaos transition in the Lorenz system.

9. V. A. Gaiko, Global bifurcation analysis of the Kukles cubic system, *International Journal of Dynamical Systems and Differential Equations* **8** (2018), no. 4, 326–336 (ISSN: 1752-3583).

   In this paper, we carry out the global bifurcation analysis of the Kukles system representing a planar polynomial dynamical system with arbitrary linear and cubic right-hand sides and having an anti-saddle at the origin. Using our geometric approach and the Wintner–Perko termination principle, we solve the problem on the maximum number and distribution of limit cycles in this system.

10. V. A. Gaiko and C. Vuik, Global dynamics in the Leslie–Gower model with the Allee effect, *International Journal of Bifurcation and Chaos* **28** (2018), no. 12, 1850151, 10 p. (ISSN (print): 0218-1274; ISSN (online): 1793-6551).

    We complete the global bifurcation analysis of the Leslie–Gower system with the Allee effect which models the dynamics of the populations of predators and their prey in a given ecological or biomedical system. In particular, studying global bifurcations of limit cycles, we prove that such a system can have at most two limit cycles surrounding one singular point.

5.2 Scientific leadership

- Annual scientific grants of Ministry of Education of Belarus (1987–2008) and National Academy of Sciences of Belarus (2009–2023)

5.3 Originality and capacity for development

5.3.1 The main research interests

- Qualitative Theory of Differential Equations

- Dynamical Systems and Bifurcation Theory

- Nonlinear Analysis and Applications
- Biomathematics

5.3.2 Independent research profile

- We have developed the global bifurcation theory of planar polynomial dynamical systems and have found a new geometric approach to solving Hilbert's Sixteenth Problem on the maximum number and relative position of their limit cycles in two special cases of such systems.

- Firstly, using geometric properties of four field rotation parameters of a new canonical system, we have proved our earlier conjecture that the maximum number of limit cycles in a quadratic system is equal to four and their only possible distribution is (3 : 1) (see: V. A. Gaiko, *Global Bifurcation Theory and Hilbert's Sixteenth Problem*, Boston: Kluwer Academic Publishers, 2003).

- Secondly, by means of the same geometric approach, we have solved the Problem for Liénard's polynomial system (in this special case, it is considered as Smale's Thirteenth Problem).

- Besides, generalizing the obtained results, we have presented a solution of Hilbert's Sixteenth Problem on the maximum number of limit cycles surrounding a singular point for an arbitrary polynomial system and, applying a canonical system with field rotation parameters and using geometric properties of the spirals filling the interior and exterior domains of limit cycles, we have solved the limit cycle problem for the general Liénard polynomial system with an arbitrary (but finite) number of singular points.

- Applying the Wintner–Perko termination principle for multiple limit cycles, we have also developed an alternative approach to solving the Problem. By means of this approach, for example, we have given another proof of the main theorem for a quadratic system and have completed the global qualitative analysis of a generalized Liénard's cubic system with three finite singularities which is very important for applications.

- Generalizing the obtained results, we have solved Hilbert's Sixteenth Problem for the Kukles cubic-linear system. We have completed the global qualitative analysis of cubic Oja and FitzHugh–Nagumo dynamical systems which can be used as learning models of planar neural networks, Holling type and Leslie–Gower systems which model the dynamics of the populations of predators and their prey in a given ecological or biomedical system and also of the Euler–Lagrange–Liénard polynomial mechanical system and a Liénard-type piecewise linear dynamical system which is well-known in radio-electronics.

  Finally, applying a similar approach, we have considered various applications of 3D polynomial dynamical systems and, in particular, completed the strange attractor bifurcation scenario in the classical Lorenz system globally connecting the homoclinic, period-doubling, Andronov–Shilnikov, and period-halving bifurcations of its limit cycles. We have also studied the 3D Topp model for the dynamics of diabetes.

5.3.3 Planned research

- We plan to develop the global bifurcation theory of dynamical systems applying our new geometric methods and to carry out, first of all, the qualitative analysis of two-dimensional polynomial systems making progress towards the complete solution of Hilbert's Sixteenth Problem on the maximum number and relative position of limit cycles for such systems. Generalizing our recent results obtained for quadratic, cubic, quartic, and Liénard-type dynamical systems, we will develop the global bifurcation theory of arbitrary polynomial systems completing the solution of the Problem in the general case of such systems.

- Since it is well-known that theory of dynamical systems and bifurcation methods can be used for mathematical modeling natural systems with complicated dynamics, we will consider possibilities of application of global bifurcation theory, for instance, to electrical engineering, radio-electronics, biology, medicine, ecology, etc. In particular, applying the obtained results, we will carry out the global qualitative analysis of two-dimensional dynamical systems such as generalized van der Pol and Liénard equations, asymmetrically perturbed Duffing oscillators, generalized Lotka–Volterra and Holling epidemiological and immunological models, FitzHugh–Nagumo and Oja type neurological models and higher-order biomedical, biomechanical and ecological systems. The obtained results will be applied to developing the global bifurcation theory of the corresponding piecewise linear dynamical systems approximating arbitrary polynomial systems which are used in various applications.

- We will also apply the bifurcation theory of planar polynomial dynamical systems to the global analysis of higher-dimensional dynamical systems and special classes of partial differential equations. In particular, by means of the Wintner principle of natural termination, we will study one-parameter families of periodic orbits of such systems and equations including the cases when the periodic orbits belong to strange invariant sets which are usually called strange attractors. By means of our geometric approach, we will study the strange attractor bifurcations and their possible applications to natural systems with complicated dynamics.

5.4 Fellowships and research grants

- **2023 two-month fellowship** — CRMC, China
- **2020 two-month fellowship** — DAAD, Germany
- **2019 four-month fellowship** — NWO, Netherlands
- **2019 five-week travel grant** — LMS, UK
- **2018 four-month fellowship** — NWO, Netherlands
- **2018 two-month fellowship** — IHÉS, France
- **2016 three-month fellowship** — DAAD, Germany
- **2016 two-week travel grant** — MOST-Belarus, France

- **2015 four-month fellowship** — NWO, Netherlands
- **2015 two-month fellowship** — IMU, USA
- **2012 two-month fellowship** — DAAD, Germany
- **2011–2012 six-month fellowship** — NWO, Netherlands
- **2011 two-month fellowship** — MPIM, Germany
- **2009 two-month fellowship** — IHÉS, France
- **2008–2009 six-month fellowship** — NWO, Netherlands
- **2007–2008 six-month fellowship** — NWO, Netherlands
- **2006 one-month fellowship** — IHÉS, France
- **2004 one-month travel grant** — AMS, USA
- **2003 six-month fellowship** — NWO, Netherlands
- **2000 two-month fellowship** — DAAD, Germany
- **2000 one-month travel grant** — NNSFC, China
- **1998 two-week travel grant** — LMS, UK
- **1996 two-month fellowship** — DAAD, Germany
- **1995 two-week travel grant** — CNRS, France

5.5 Extramural scientific activities and assignments

5.5.1 Mathematical journals and reviews

- **Computer Research and Modeling** — editorial board member
- **Differential Equations and Dynamical Systems** — editorial board member
- **Electronic J. of Qualitative Theory of Differential Equations** — referee
- **Dynamics of Continuous, Discrete and Impulsive Systems** — referee
- **Journal of Difference Equations and Applications** — referee
- **Nonlinear Phenomena in Complex Systems** — referee
- **Advances in Difference Equations** — referee
- **Journal of Applied Mathematics** — referee
- **Nonlinear Analysis** — referee
- **Nonlinearity** — referee
- **Zentralblatt MATH** — reviewer

5.5.2 Special courses

- **Global Bifurcation Analysis of Polynomial Dynamical Systems** — four lectures given for stuff and graduate students, June 2023, School of Mathematics, Dalian University of Technology, China

- **Global Bifurcation Theory and Applications of Polynomial Dynamical Systems** — three lectures given for stuff and graduate students, May – June 2023, School of Mathematics, Sichuan University, China

- **Bifurcations of Dynamical Systems** — eight lectures given for stuff and graduate students, September – December 2022, Higher School of Mechanics and Control Processes, Peter the Great St. Petersburg Polytechnic University, Russia

- **Qualitative and Geometric Methods for Analysis of Nonlinear Dynamical Systems** — three lectures given for stuff and postgraduate students, December 2013, Department of Computer Science, Physics, and Mathematics, Linnaeus University, Växjö, Sweden

- **Global Bifurcation Theory of Dynamical Systems** — six lectures given for stuff and postgraduate students, July 2004, Department of Mathematical Sciences, The University of Memphis, Memphis, USA

5.5.3 International congresses

- **The Tenth International Congress on Industrial and Applied Mathematics, August 2023, Tokyo, Japan** — chairman and invited speaker of the session “Qualitative and Asymptotic Theory for Ordinary Differential Equations”

- **The Thirteenth International ISAAC Congress, August 2021, Ghent, Belgium** — invited speaker of the session “Applications of Dynamical Systems Theory in Biology”

- **The Twelfth International ISAAC Congress, July 2019, Aveiro, Portugal** — invited speaker of the session “Applications of Dynamical Systems Theory in Biology”

- **The International Congress of Mathematicians, August 2018, Rio de Janeiro, Brazil** — speaker of the session “Dynamical Systems and Ordinary Differential Equations”

- **The International Congress of Mathematicians, August 2014, Seoul, Korea** — speaker of the session “Dynamical Systems and Ordinary Differential Equations”

- **The Ninth International ISAAC Congress, August 2013, Kraków, Poland** — invited speaker of the session “Differential and Difference Equations with Applications”

- **The Sixth European Congress of Mathematics, July 2012, Kraków, Poland** — speaker of the session “Ordinary Differential Equations and Dynamical Systems”

- **The Seventh International Congress on Industrial and Applied Mathematics, July 2011, Vancouver, Canada** — speaker of the session "Dynamical Systems and Nonlinear Analysis"

- **The International Congress of Mathematicians, August 2010, Hyderabad, India** — speaker of the session "Dynamical Systems and Ordinary Differential Equations"

- **The Seventh International ISAAC Congress, July 2009, London, UK** — invited speaker of the session "Dynamical Systems"

- **The Fifth European Congress of Mathematics, July 2008, Amsterdam, Netherlands** — speaker of the session "Ordinary Differential Equations and Dynamical Systems"

- **The Fifth World Congress of Nonlinear Analysts, July 2008, Orlando, USA** — member of the Global Organizing Committee; organizer (jointly with F.Botelho) of the session "Qualitative Theory and Applications of Dynamical Systems"

- **The Fourth World Congress of Nonlinear Analysts, July 2004, Orlando, USA** — member of the Global Organizing Committee; organizer, chairman (jointly with F.Botelho) and invited speaker of the session "Dynamical Systems: Bifurcations and Applications"

- **The Fourth European Congress of Mathematics, June – July 2004, Stockholm, Sweden** — speaker of the session "Ordinary Differential Equations and Dynamical Systems"

- **The Third International ISAAC Congress, August 2001, Berlin, Germany** — invited speaker of the session "Dynamical Systems"

- **The Third World Congress of Nonlinear Analysts, July 2000, Catania, Italy** — member of the Global Organizing Committee; organizer, chairman and invited speaker of the session "Dynamical Systems and Qualitative Theory of Differential Equations"

- **The Fourth International Congress on Industrial and Applied Mathematics, July 1999, Edinburgh, Scotland, UK** — speaker of the session "Analysis, Asymptotics and Ordinary Differential Equations"

- **The International Congress of Mathematicians, August 1998, Berlin, Germany** — speaker of the session "Dynamical Systems and Ordinary Differential Equations"

- **The Second European Congress of Mathematics, July 1996, Budapest, Hungary** — speaker of the session "Ordinary Differential Equations and Dynamical Systems"

- **The Second World Congress of Nonlinear Analysts, July 1996, Athens, Greece** — member of the Global Organizing Committee; organizer, chairman and invited speaker of the session "Qualitative Theory of Differential Equations"

5.6 Scientific seminars and colloquiums

- **June 2023** — Dalian University of Technology, Dalian, China (Yi Fengqi)
- **May 2023** — Sichuan University, Chengdu, China (Zhang Weinian)
- **December 2022** — Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia (A.B.Freidin, R.A.Filippov)
- **September 2020** — Technische Universität Dresden, Dresden, Germany (S.Siegmund)
- **January 2020** — Innopolis University, Innopolis, Russia (A.S.Klimchik)
- **October 2019** — University of Groningen, Groningen, Netherlands (H.Broer)
- **February 2019** — University of Warwick, Coventry, UK (R.MacKay)
- **September 2018** — Delft University of Technology, Delft, Netherlands (C.Vuik)
- **April 2018** — Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France (M.Kontsevich)
- **June 2017** — Université de Toulon, Toulon, France (J.-M.Ginoux)
- **September 2016** — Technische Universität Dresden, Dresden, Germany (S.Siegmund)
- **June 2016** — Université de Toulon, Toulon, France (J.-M.Ginoux)
- **November 2015** — Delft University of Technology, Delft, Netherlands (W. van Horssen)
- **October 2015** — University of Groningen, Groningen, Netherlands (H.Broer)
- **April 2015** — Missouri University of Science and Technology, Rolla, USA (M.Bohner)
- **December 2013** — Linnaeus University, Växjö, Sweden (T.Lindström)
- **November 2013** — Stockholm University, Stockholm, Sweden (P.Kurasov)
- **October 2012** — Technische Universität Ilmenau, Ilmenau, Germany (J.Knobloch)
- **April 2012** — Institute of Mathematics, National Academy of Sciences of Ukraine, Kiev, Ukraine (V.V.Sharko)
- **March 2012** — Institute of Mathematics, National Academy of Sciences of Ukraine, Kiev, Ukraine (A.M.Samoilenko)

- **January 2012** — University of Groningen, Groningen, Netherlands (H.Broer)
- **March 2011** — Max Plank Institute for Mathematics, Bonn, Germany (G.Faltings, D.Zagier)
- **October 2010** — Novosibirsk State University, Novosibirsk, Russia (I.A.Taimanov)
- **September 2010** — Sobolev Institute of Mathematics, Russian Academy of Sciences, Novosibirsk, Russia (S.K.Godunov)
- **July 2009** — Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France (M.Gromov, M.Kontsevich)
- **February 2009** — University of Groningen, Groningen, Netherlands (H.Broer)
- **March 2008** — University of Utrecht, Utrecht, Netherlands (O.Diekmann)
- **March 2008** — Stockholm University, Stockholm, Sweden (B.Shapiro)
- **March 2008** — Lund University, Lund, Sweden (P.Kurasov)
- **February 2008** — University of Groningen, Groningen, Netherlands (H.Broer)
- **January 2008** — Delft University of Technology, Delft, Netherlands (W. van Horssen)
- **June 2007** — University of Latvia, Riga, Latvia (A.Reinfelds)
- **January 2006** — Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France (M.Gromov, M.Kontsevich)
- **May 2005** — University of Missouri-Rolla, Rolla, USA (M.Bohner)
- **January 2005** — University of Memphis, Memphis, USA (F.Botelho)
- **July 2004** — Northern Arizona University, Flagstaff, USA (L.M.Perko)
- **July 2004** — University of Memphis, Memphis, USA (F.Botelho)
- **July 2004** — University of Tennessee, Chattanooga, USA (J.R.Graef)
- **July 2004** — University of North Carolina, Charlotte, USA (D.S.Shafer)
- **October 2003** — Université de Nice, Nice, France (V.Kostov)
- **September 2003** — Delft University of Technology, Delft, Netherlands (W. van Horssen)
- **December 2000** — University of Kalmar, Kalmar, Sweden (T.Lindström)
- **November 2000** — Universität Giessen, Giessen, Germany (T.Bartsch)

- **November 2000** — Technische Universität Ilmenau, Ilmenau, Germany (J.Knobloch)
- **October 2000** — Weierstrass Institut für Angewandte Analysis und Stochastik, Berlin, Germany (K.Schneider)
- **April 2000** — Fuzhou University, Fuzhou, China (Yang Xinan)
- **April 2000** — Shanghai Normal University, Shanghai, China (Zhu Deming)
- **April 2000** — Nanking University, Nanking, China (Ye Yanqian)
- **April 2000** — Peking University, Beijing, China (Zhang Zhifen, Li Chengzhi)
- **June 1999** — St. Petersburg State University, St. Petersburg, Russia (V.A.Pliss)
- **May 1999** — Institute of Mathematics, National Academy of Sciences of Ukraine, Kiev, Ukraine (A.M.Samoilenko)
- **April 1999** — Universitat Autònoma de Barcelona, Barcelona, Spain (J.Llibre)
- **April 1999** — Universita degli Studi di Firenze, Florence, Italy (G.Villari)
- **March 1999** — Université de Nice, Nice, France (V.Kostov)
- **March 1999** — Université de Toulouse, Toulouse, France (L.Gavrilov)
- **March 1999** — Université de Bourgogne, Dijon, France (R.Roussarie)
- **March 1999** — Institute of Mathematics, National Academy of Sciences of Belarus, Minsk, Belarus (I.V.Gaishun)
- **January 1999** — University of Warsaw, Warsaw, Poland (H.Żoladek)
- **August 1998** — Weierstrass Institut für Angewandte Analysis und Stochastik, Berlin, Germany (K.Schneider)
- **April 1998** — University of Wales, Aberystwyth, Wales, UK (N.G.Lloyd)
- **April 1998** — University of Leeds, Leeds, UK (B.D.Sleeman)
- **April 1998** — Manchester Metropolitan University, Manchester, UK (S.Lynch)
- **March 1998** — Université de Bourgogne, Dijon, France (R.Roussarie)
- **March 1997** — Technische Universität Ilmenau, Ilmenau, Germany (J.Knobloch)
- **November 1996** — Universität Gesamthochschule Kassel, Kassel, Germany (J.Hainzl)
- **November 1996** — Technische Universität Ilmenau, Ilmenau, Germany (J.Knobloch)

- **November 1996** — Universität Giessen, Giessen, Germany (T.Bartsch)
- **November 1996** — Université de Bourgogne, Dijon, France (R.Roussarie)
- **November 1996** — Limburgs Universitair Centrum, Diepenbeek, Belgium (F.Dumortier)
- **October 1996** — Universität Hohenheim, Stuttgart, Germany (M.Bohner)
- **May 1996** — Universita degli Studi di Firenze, Florence, Italy (G.Villari)
- **April 1996** — Henri Poincaré Institut, Paris, France (J.-P.Françoise)
- **April 1996** — Université de Bourgogne, Dijon, France (R.Roussarie)
- **May 1995** — Delft University of Technology, Delft, Netherlands (J.W.Reyn)
- **April 1995** — University of Wales, Aberystwyth, Wales, UK (N.G.Lloyd)
- **April 1995** — University of Strathclyde, Glasgow, Scotland, UK (M.Grinfeld)
- **April 1995** — Université de Nice, Nice, France (V.Kostov)
- **April 1995** — Henri Poincaré Institut, Paris, France (J.-P.Françoise)
- **April 1995** — Université de Bourgogne, Dijon, France (R.Roussarie)
- **April 1995** — Technische Universität Ilmenau, Ilmenau, Germany (J.Knobloch)

5.7 Abstracts of conferences and seminars during the past five years

1. V. A. Gaiko, Global bifurcations in multi-parameter dynamical systems, *Abs. XXVI Int. Conf. Mathematics. Computing. Education*, Jan. 28 – Febr. 2, 2019, Pushchino (Moscow), Russia, http://www.mce.su/archive/doc332497/eng.pdf.

2. V. A. Gaiko, Limit cycles of planar polynomial dynamical systems, *Abs. Warwick Sem. Ergodic Theory and Dynamical Systems*, February 26, 2019, Coventry, UK, https://warwick.ac.uk/fac/sci/maths/research/events/seminars/areas/dynamics/2018-19.

3. V. A. Gaiko, Qualitative analysis of multi-parameter polynomial dynamical systems, *Abs. 24th Int. Conf. Mathematical Modelling and Analysis (MMA 2019)*, May 28–31, 2019, Tallinn, Estonia, https://www.ttu.ee/institutes/department-of-cybernetics/conferences-19 /mathematical-modelling-and-analysis-2019/abstracts.

4. V. A. Gaiko, On multi-parameter bifurcation theory and applications of continuous and discrete dynamical systems, *Abs. 25th Int. Conf. Difference Equations and Applications (ICDEA 2019)*, June 24–28, 2019, London, UK, https://www.ucl.ac.uk /maths/home/icdea-2019/icdea-2019-abstract.

5. V. A. Gaiko, Limit cycle bifurcations in multi-parameter polynomial dynamical systems, *Book of Abs. Int. Conf. Differential Equations (Equadiff 2019)*, July 8–12, 2019, Leiden, The Netherlands, p. 32.

6. V. A. Gaiko, Limit cycles and strange attractors in multi-parameter dynamical systems, *Abs. Int. Congr. Industrial and Applied Mathematics (ICIAM 2019)*, July 15–19, 2019, Valencia, Spain, https://iciam2019.org/index.php/infomation-for-delegates/abstracts.

7. V. A. Gaiko, Global bifurcations of limit cycles and strange attractors in multi-parameter polynomial dynamical systems, *Volume of Abs. 12th Int. Congr. Analysis, Applications and Computation (ISAAC 2019)*, July 29 – Aug. 2, 2019, Aveiro, Portugal, p. 21.

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15. V. A. Gaiko, Bifurcations and applications of multi-parameter continuous and discrete dynamical systems, *Abs. 26th Int. Conf. Difference Equations and Applications (ICDEA 2021)*, July 26–30, 2021, Sarajevo, Bosnia and Herzegovina, p. 152.

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17. V. A. Gaiko, Global bifurcation theory and applications of planar polynomial dynamical systems, *Abs. Int. Conf. of World-Class International Mathematical Centers*, Aug. 9–13, 2021, Sochi, Russia, https://siriusmathcenter.ru/all-russian-conference/program.

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22. V. A. Gaiko, Bifurcation and topological methods for polynomial dynamical systems, *Abs. Book Int. Conf. Dynamics, Topology and Computation (DyToComp 2022)*, June 20–25, 2022, Będlewo (Warszawa), Poland, p. 4.

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25. V. A. Gaiko, Global bifurcations and multistability in continuous and discrete dynamical systems, *Abs. 27th Int. Conf. Difference Equations and Applications (ICDEA 2022)*, July 18–22, 2022, Gif-sur-Yvette (Paris), France, https://icdea2022.sciencesconf.org/user/submissions.

26. V. A. Gaiko, Global bifurcation analysis and multistability in multi-parameter polynomial dynamical systems, *Abs. Int. Conf. Dynamics Days Europe 2022 (DDE 2022)*, Aug. 22–26 2022, Aberdeen, Scotland, UK, https://www.abdn.ac.uk/events/conferences/contributed-talks-2199.php.

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35. V. A. Gaiko, Applications of polynomial dynamical systems, *Abs. Scientific Seminar of School of Mathematics, Dalian University of Technology*, June 21, 2023, Dalian, China, https://dbji.dlut.edu.cn/English/Research/ResearchPrograms.htm.

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39. V. A. Gaiko, Global bifurcation analysis and multistability of polynomial dynamical systems, *Abs. Int. Conf. XLIII Dynamics Days Europe (DDE 2023)*, Sept. 3–8, 2023, Naples, Italy, https://sites.google.com/view/dynamicsdayseurope2023/abstracts.

6 Teaching qualifications

6.1 Teaching experience

- **September – December 2022** — Bifurcations of Dynamical Systems (Peter the Great St. Petersburg Polytechnic University, graduate course, 16 hours)
- **1993 – 2008** — Linear Algebra and Analytic Geometry, Real and Complex Analysis, Differential Equations and Dynamical Systems (Belarusian State University of Informatics and Radioelectronics, lectures, basic level, about 800 hours per year)
- **January – May 2005** — Math 3243 "Introduction in Linear Algebra" (University of Memphis, lectures, undergraduate course, 50 hours)
- **January – May 2005** — Math 2000 "Experiences in Mathematics" (University of Memphis, lectures, undergraduate course, 50 hours)
- **1987–1992** — Linear Algebra and Analytic Geometry, Real and Complex Analysis, Differential Equations and Dynamical Systems (Belarusian State University of Informatics and Radioelectronics, seminars, basic level, about 800 hours per year)

6.2 Acquittal in the role of teacher

1. V. A. Gaiko, Isocline classification of quadratic systems, *Abs. Int. Conf. Bicentennial Anniversary of N.I.Lobachevskii*, December 4–8, 1992, Minsk, Belarus, Part 2, p. 27 (Russian).
2. V. A. Gaiko, Bifurcations of limit cycles and classification of separatrix cycles in polynomial systems, *Abs. First Int. School–Workshop Foundations of Synergetics*, October 11–13, 1994, Minsk, Belarus, p. 6.
3. V. A. Gaiko, Global analysis of generalized Lotka–Volterra systems, *Abs. Sixth Int. Conf. Mathematics. Computer. Education*, January 24–30, 1999, Pushchino, Russia, p. 317.
4. V. A. Gaiko, On teaching theory of dynamical systems, *Abs. Int. Math. Conf. Erugin Readings – VI*, May 20–21, 1999, Gomel, Belarus, Part 2, pp. 90–91 (Russian).
5. V. A. Gaiko, Termination principle and global bifurcations of limit cycles, *Abs. Seventh Int. School–Workshop Nonlinear Dynamics and Complex Systems*, September 7–10, 1999, Raubichi (Minsk), Belarus, p. 5.

6. V. A. Gaiko, Global bifurcations of limit cycles in generalized Lotka–Volterra systems, *Abs. Seventh Int. Conf. Mathematics. Computer. Education*, January 23–30, 2000, Dubna (Moscow), Russia, p. 384.

7. V. A. Gaiko, Modern mathematics – into universities: dynamical systems and bifurcation theory, catastrophe theory and synergetics, *Abs. Ninth Int. Congr. Mathematical Education*, July 31 – August 6, 2000, Tokyo, Japan, p. 149.

8. V. A. Gaiko, On the book by Stephen Lynch "Dynamical systems with applications using Maple", *Abs. Int. Math. Conf. Erugin Readings – VII*, May 28–30, 2001, Grodno, Belarus, pp. 194–195.

9. V. A. Gaiko, Some open problems in global bifurcation theory, *Abs. Ninth Int. Workshop Nonlinear Dynamics and Complex Systems*, September 17–20, 2001, Minsk, Belarus, p. 4.

10. V. A. Gaiko, On the book "Global Bifurcations of Limit Cycles and Hilbert's Sixteenth Problem", *Abs. Ninth Int. Conf. Mathematics. Computer. Education*, January 28 – February 2, 2002, Dubna (Moscow), Russia, p. 90.

11. V. A. Gaiko, Center points in polynomial dynamical systems, *Abs. Tenth Int. Workshop Nonlinear Dynamics and Complex Systems*, September 23–26, 2002, Minsk, Belarus, p. 5.

12. V. A. Gaiko, On limit cycle bifurcations in cubic systems, *Abs. Eleventh Int. School–Conf. Foundations and Advances in Nonlinear Science*, September 22–25, 2003, Minsk, Belarus, p. 30.

13. V. A. Gaiko, Global bifurcation analysis of a generalized Lotka–Volterra system, *Abs. Eighteenth Int. Conf. Mathematics. Computer. Education*, January 24–29, 2011, Pushchino, Russia, p. 122.

14. V. A. Gaiko, Dynamical systems and bifurcation theory, catastrophe theory and synergetics into universities, *Proc. Int. Sci. Practical Conf. Mathematics in the Modern Technical University*, April 19–20, 2013, Kiev, Ukraine, pp. 436–437.

6.3 Readiness to bring about renewal

1. V. A. Gaiko, Differential equations, in *Individual Home-Works on Higher Mathematics for First-Year Students of Radioengineering Specialization*, A.A.Karpuk and R.M.Zhevniak, Eds, Minsk: Radioengineering Institute, Part 4, 1990, pp. 39–45 (Russian).

2. V. A. Gaiko, *Work Program on Higher Mathematics for Telecommunication Systems Specialization*, Minsk: Belarusian State University of Informatics and Radioelectronics, 1995, 24 p. (Russian).

3. V. I. Bernik, V. A. Gaiko et al., *Mathematical Encyclopedia*, Minsk: Technology, 2001, 496 p. (Belarusian).

4. V. A. Gaiko, *Work Program on Higher Mathematics for Electronic Computing Systems, Electronic and Optic Device Construction, and Medical Electronics Specializations*, Minsk: Belarusian State University of Informatics and Radioelectronics, 2002–2008, 9 p. (Russian).

6.4 Supervision or similar tasks

- Annual supervision of students for student scientific conference and olympiads

6.5 Teaching philosophy

- **Teaching project "Modern Mathematics – into Universities: Dynamical Systems and Bifurcation Theory, Catastrophe Theory and Synergetics"**

  There is a rapidly-growing necessity in the development and application of new, corresponding to the needs of modern science and technology, mathematical methods and techniques at present. The most important role in this connection is played by **Theory of Dynamical Systems** which is successfully applied for the qualitative analysis of various mathematical models in physics, chemistry, biology, ecology, etc. This theory, being a branch of the qualitative theory of differential equations, was originated at the end of the XIX century by H.Poincaré and A.M.Lyapunov. New theories were created on its basis: **Bifurcation Theory** describing qualitative (jump-like) changes under continuous (smooth) variation of parameters in a system; **Catastrophe Theory** combining singularity theory (describing bifurcations of singular points), bifurcation theory and their applications; **Synergetics** which is a theory of self-organizing processes in various systems [1].

  Using these theories, we have to improve academic programs on calculus and general course of differential equations, to prepare the corresponding special courses and, combining with computing systems like *MATHEMATICA* (for the wide spectrum of applications), *MAPLE* (for solving ordinary differential equations) and with more specific computer packages like *SOLVER* (for numerical solving sets of simultaneous differential equations), *PHASER* (for simulation problems and investigation of dynamical systems), to apply them for research and training of specialists of the highest qualification in theory of dynamical systems and related topics.

  For solving these teaching problems we could recommend, for example, the book **"Dynamical systems with applications using *MAPLE*" by Stephen Lynch** [2] (see also [3–5]). The book [2] provides an introduction to theory of dynamical systems with aid of the *MAPLE* algebraic manipulation package. It is aimed at both final-year undergraduates and postgraduates students, and is appropriate for engineers and scientists. Some of its chapters are concerned with recently published research articles and provide a useful source for project works on the bifurcation theory, multistability, periodicity, chaos, etc. The advantages of the book are the following.

  – A *MAPLE* tutorial is listed at front of the book.

  – Aims and objectives are given at the beginning of each chapter.

- There are over 300 individual figures, and over 250 examples and exercises with solutions in [2].
- There is a very helpful web-site with colour pictures supporting the book.
- This book takes the reader from basics to recently published research papers.
- Some topics of [2] are not covered elsewhere.
- The book provides with very interesting applications from diverse fields of science: economics, population dynamics, nonlinear optics and materials science.
- It avoids cumbersome mathematics, and the reader will find it interesting and easy to understand.

1. V. A. Gaiko, *Global Bifurcation Theory and Hilbert's Sixteenth Problem*, Boston: Kluwer Academic Publishers, 2003.
2. S. Lynch, *Dynamical Systems with Applications Using MAPLE*, Basel: Birkhäuser, 2000.
3. S. Lynch, *Dynamical Systems with Applications Using MATLAB*, Basel: Birkhäuser, 2004.
4. S. Lynch, *Dynamical Systems with Applications Using Mathematica*, Basel: Birkhäuser, 2006.
5. S. Lynch, *Dynamical Systems with Applications Using Python*, Basel: Birkhäuser, 2018.