

JUSTYNA SIGNERSKA-RYNKOWSKA

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Dioscuri Centre in Topological Data Analysis
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Education

- 2009 - 2013 Ph. D. studies** at the Institute of Mathematics of the Polish Academy of Sciences (acclaimed as **Leading National Research Centre** for 2012-2017 by Ministry of Science and Higher Education in Poland) in the field of *Mathematics* under supervision of prof. W. Marzantowicz (the Ph.D. advisor) and prof. F. Przytycki (co-advisor), **Ph.D. in Mathematics** in June 2013; title of Ph. D. Thesis “Dynamical properties of maps arising in some models of neuron activity and electrical circuits”
- 2004 - 2009** Gdańsk University of Technology (Poland), Faculty of Applied Physics and Mathematics, **M. Sc. Eng. in Applied Mathematics** in July 2009 (with final grade *excellent*); title of Master Thesis: “Mathematical Analysis of Some Simple Spiking Neuron Models”
- 2000 - 2004** International Baccalaureate School No 0704 in Gdynia (Poland) (International Baccalaureate Diploma)

Employment

- Oct 2021-now post-doctoral position** at the [Dioscuri Centre in Topological Data Analysis](#) (Institute of Mathematics, Polish Academy of Sciences)
- Since 2016 assistant professor** at [Gdańsk University of Technology](#), Faculty of Applied Physics and Mathematics, Division of Differential Equations and Mathematics Applications (currently on leave)
- 2014 - 2016 post-doctoral position** at [INRIA Paris-Centre \(EPI MYCENAE\)](#) and [Mathematical Neuroscience Lab, CIRB - Collège de France](#)
- 2013 - 2014 post-doctoral position** at the [Institute of Mathematics of the Polish Academy of Sciences](#) (Department of Dynamical Systems)
- 2012 - 2014 Organization and Training Coordinator** in the Project “Center for Applications of Mathematics” at [Gdańsk University of Technology](#)
- 2009 - 2012 lecturer** at the Faculty of Applied Physics and Mathematics, [Gdańsk University of Technology](#) (Department of Non-linear Analysis)

Research Interests

- dynamical systems, chaos theory, topological methods in dynamical systems
- application of dynamical systems theory to modelling of biological and physical phenomena, especially applications in neuroscience

Publications (selected)

- J.E. Rubin, **J. Signerska-Rynkowska**, J.D. Touboul, *Type III Responses to Transient Inputs in Hybrid Nonlinear Neuron Models*, SIAM J. Appl. Dyn. Syst. 20 (2021), 953--980
- G. Graff, **J. Signerska-Rynkowska**, *Dynamics of field line mappings in magnetic flux tubes*, Math. Phys. Anal. Geom. 21 (2018), p. 21-26
- P. Kasprzak, A. Nawrocki, **J. Signerska-Rynkowska**, *Integrate-and-fire models with an almost periodic input function*, J. Differential Equations 264 (2018), p. 2495--2537
- J.E. Rubin, **J. Signerska-Rynkowska**, J.D. Touboul, A. Vidal, *Wild oscillations in a nonlinear neuron model with resets: (II) Mixed-mode oscillations*, Discrete Contin. Dyn. Syst. Ser. B, 22 (2017), p. 4003-4039.
- J.E. Rubin, **J. Signerska-Rynkowska**, J.D. Touboul, A. Vidal, *Wild oscillations in a nonlinear neuron model with resets: (I) Bursting, spike adding and chaos*, Discrete Contin. Dyn. Syst. Ser. B, 22 (2017), p. 3967-4002.
- J. Signerska-Rynkowska, *Analysis of interspike-intervals for the general class of integrate-and-fire models with periodic drive*, Mathematical Modeling and Analysis, 20 (2015), 529--551
- W. Marzantowicz, **J. Signerska**, *On the regularity of the displacement sequence of an orientation preserving circle*, Research and Communications in Mathematics and Mathematical Sciences, 5 (2015), 11-32
- W. Marzantowicz, **J. Signerska**, *On the interspike-intervals of periodically-driven integrate-and-fire models*, Journal of Mathematical Analysis and Applications, 423 (2015), 456--479
- W. Marzantowicz, **J. Signerska**, *Distribution of the displacement sequence of an orientation preserving circle homeomorphism*, Dynamical Systems: An International Journal, 29 (2014), no. 2, 153-166
- G. Graff, A. Kaczowska, P. Nowak-Przygocki, **J. Signerska**, *Lefschetz periodic point free self-maps of compact manifolds*, Topology and its Applications, 159 (2012), 2728-2735
- W. Marzantowicz, **J. Signerska**, *Firing map of an almost periodic input function*, Discrete and Continuous Dynamical Systems, Supplement 2011-2 (2011), 1032-1041

Grants and Awards

- **Principal Investigator** in the "**SONATA**" grant *Challenges of low-dimensional dynamics in hybrid neuron models*, awarded by National Science Centre in Poland in May 2020 (duration: 36 months)
- team member in "*ScienceApp* -intensive international educational programs in exact sciences" (project within the frame of the **SPINNAKER** program, granted by the Polish National Agency for Academic Exchange/ Funds (**NAWA**))
- honorable mention in Edyta Szymańska competition for scientific papers published in 2017-2018, organized by Adam Mickiewicz University in Poznań
- co-investigator in the "**OPUS**" grant *Topological Invariants and Complexity Measures in Action*, awarded by National Science Centre in Poland in May 2015
- **Principal Investigator** in the pre-doctoral grant "**PRELUDIUM**" awarded by National Science Centre in Poland in December 2011 for executing the project *Properties of dynamical systems used in mathematical modelling of neurons activity and electrical circuits* (duration: 24 months)
- Rector's Awards (Gdańsk University of Technology): for outstanding scientific achievements (individual, 2017), research-and-development activity (individual, 2020), organizational activity (team award, 2018 and 2020)
- Scholarship of the Ministry of Science and Higher Education for academic achievements in

academic years 2006/2007, 2007/2008, 2008/2009

- Scholarship of the Marshal of Pomeranian Voivodeship for academic achievements in academic years 2007/2008, 2008/2009 and of Mayor of Gdynia/Gdańsk in 2006/2007, 2007/2008

Short-term scientific visits (selected)

- 28-31 August 2016, **Linköping University** (Sweden), Department of Mathematics
- 1-8 June 2016 and 2-11 December 2013, Center for Interdisciplinary Research in Biology, **Collège de France**, Paris: visiting the group of Jonathan Touboul and working on the project “Wild dynamics in nonlinear integrate-and-fire neurons: mixed-mode bursting, spike adding and chaos”
- 15-29 January 2014, Instituto de Ciências Matemáticas e de Computação, **Universidade de São Paulo**, São Carlos –SP, Brasil: visiting the group of Ali Tahzibi and working on the project about geometrical properties of curlicues generated by circle maps and other dynamical systems
- 7-11 January 2013, **Ecole Normale Supérieure** (Paris): visiting the group of Romain Brette in theoretical and computational neuroscience

Attended Conferences and Workshops (after 2014, selected)

- 20 – 26 June 2021, Portorož (Slovenia) – virtual conference, **8th European Congress of Mathematics; minisymposium invited talk** *Dynamical mechanisms of Type III responses in a nonlinear hybrid neuron model*
- 23 - 27 May 2021, Portland (USA) – virtual conference, **SIAM Conference on Applications of Dynamical Systems; minisymposium invited talk** *Type III Responses to Transient Inputs in a Nonlinear Hybrid Neuron Model*
- 27 February – 1 March 2020, Gdańsk (Poland), **Wandering Seminar, Organizing Committee**
- 3 – 7 September 2019, Cracov (Poland), Jubilee Congress for the 100th anniversary of the Polish Mathematical Society (Jubileuszowy Zjazd Matematyków Polskich w stulecie PTM), **talk** *Teoria rotacji w hybrydowych modelach neuronów* (in Polish)
- 31 August – 2 Sept 2019, Cracov, **On the Trail of Women in Mathematics - in Honor of Sofia Kowalewska; invited session talk** *Integrate-and-fire models with an almost periodic input function*
- 10–14 June 2019 Cracov, **Conference on Dynamical Systems Celebrating Michał Misiurewicz's 70th Birthday, talk** *Period incrementing and chaos in a hybrid neuron model*
- 15-21 April 2018, Będlewo (Poland), **Surfaces in Będlewo, Organizing Committee**
- 18-22 September 2017, Lublin (Poland), **8th Forum of Polish Mathematicians, co-organizer of session** *Topological Methods in Dynamical Systems, talk* *Curlicues generated by circle homeomorphisms*
- 13-19 August 2017, Będlewo (Poland), **Just a Little Calculation in Dynamics; talk** *Rotation theory and mixed-mode oscillations in a hybrid neuron model*
- 22-24 June 2017, Rzeszów (Poland), **Women in Mathematics: conference in honor of Helena Rasiowa; invited session talk** *Period-incrementing and chaos in hybrid neuron model*

- 30 May – 2 June 2017, Boulder (Colorado, USA), **3rd International Conference on Mathematical NeuroScience**; talk *Complex oscillations in a hybrid neuron model: bursting, spike-adding and chaos*
- 3-7 October 2016, CIRM - Marseille, **Surfaces in Luminy**, poster *Rotation theory in analysing hybrid neuron models*
- 18-22 July 2016, Berlin, **7th European Congress of Mathematics**, talk *Rotation theory in analysis of complex oscillations in a hybrid neuron model*
- 30 May – 1 June 2016, Antibes-Juan Les Pins (France), **2nd International Conference on Mathematical NeuroScience**; poster *Circle maps and rotation theory in analysing hybrid neuron models*
- 25-30 May 2015, Będlewo (Poland), **Between Theory and Applications: Mathematics in Action**; chairman and organizer of session *Dynamical systems in modeling of neural activity*; lecture *Discontinuous interval mappings in analysis of integrate-and-fire models*
- 16-21 May 2015, Snowbird (Utah, USA), **SIAM Conference on Applications of Dynamical Systems**; poster *A geometric mechanism for mixed-mode bursting oscillations in a hybrid neuron model*

Seminars given (after 2012, selected)

- 1) **Polish Women in Mathematics Seminar** (PolWoMaths Seminar) “Selected problems of low-dimensional dynamics in neurons modeling” (2021)
- 2) **Linköping University** (Sweden), Department of Mathematics, “Complex oscillations in a nonlinear neuron model with resets”
- 3) **Instituto de Ciências Matemáticas e de Computação, Universidade de São Paulo, São Carlos** (Brasil), “Displacement sequence of an orientation preserving circle homeomorphism” and “Firing map and interspike-intervals for one-dimensional integrate-and-fire models”
- 4) **Institute of Mathematics of PAS, Warsaw**, *Dynamical systems* seminar, “Firing map for periodically and almost-periodically driven integrate-and-fire models: a dynamical systems approach” and “Curlicues generated by circle maps”
- 5) **Jagiellonian University in Cracov**, *Dynamical systems* seminar, “Analysis of a neuron dynamics model with a periodic and almost periodic input function”
- 6) **Adam Mickiewicz University in Poznan**, *Seminar in Nonlinear Analysis*, “Analysis of a neuron dynamics model with an almost periodic input function”

Skills and Techniques

- Knowledge of Mathematica and Matlab programming
- Languages: English (Certificate in Advanced English-CAE); German (Goethe-Zertifikat C1); French (intermediate)

Memberships

Since 2014 Polish Mathematical Society (PTM), since January 2017 treasurer of the Gdansk Branch

Since 2020 Polish Women in Mathematics Society (PTKM)