CURRICULUM VITAE

Personal information

Family name: Pokutnyi
First name: Oleksandr
Nationality: Ukrainian

Year of birth: 1983
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Education

Sep 2014-March 2017	*Institute of Mathematics of NAS of Ukraine*

Doctor of physical and mathematical sciences

Date of defense:	07.03.2017
Dissertation title:	*Normally-resolvable boundary value problems for operator-differential equations*
Expected duration:	3 years
Actual dissertation:	2 years and 6 months
Nov 2006-Sep 2009	*Institute of Mathematics of NAS of Ukraine*

PhD in mathematics,   *Differential equations*

Diploma was issued: 16.12.2009
Date of defense: 22.09.2009

Dissertation title:	*Solutions of differential equations in Banach space bounded on the entire real axis*

Sep 2005-Jun 2007,   *Taras Shevchenko National University of Kyiv*
Master in computer science,   *Department of Numerical Mathematics*
Faculty of Cybernetics,
Diploma was issued: 20.06.2007

Sep 2005-Jun 2006,   *Taras Shevchenko National University of Kyiv*
Specialist in mathematics   *Department of Differential Equations*
Faculty of Mechanics and Mathematics
Diploma was issued: 21.06.2006

Sep 2001-Jun 2005,   *Taras Shevchenko National University of Kyiv*
Bachelor in computer sciences   *Department of Numerical Mathematics*
Faculty of Cybernetics
Diploma was issued: 25.06.2005

Sep 2001-June 2005,   *Taras Shevchenko National University of Kyiv*
Bachelor in mathematics   *Department of Differential Equations*
Faculty of Mechanics and Mathematics
Diploma was issued: 30.06.2005

Summary of the doctoral dissertation

The dissertation has a practical meaning. The main goal is a development of algorithms for solving of boundary-value problems which model natural processes in physics, mathematical biology, neural networks, chemistry and prediction (including tasks to weather forecasting), agricultural sciences and ill-posed chaotic systems.

The thesis is dedicated to the investigation of solvability conditions of boundary-value problems for the operator-differential equations. For operator-differential boundary value problems linearized part of which is a normally resolvable operator a theory of solvability has been constructed. The necessary and sufficient conditions of the existence of bounded on the entire real axis solutions of the operator-differential equations in the Frechet, Banach and Hilbert spaces are obtained under assumption that the corresponding homogeneous equation admits an exponential dichotomy on the semi-axes. The criteria of solvability of operator-differential boundary value problems in the Frechet, Banach and Hilbert spaces are obtained in the thesis.

For a linear operator equations with a bounded operator in Frechet and Banach spaces, when the corresponding operator has a nonclosed set of values, notions of strong generalized solutions and quasisolutions are proposed. The theory of solvability and the corresponding solutions of such equations have been constructed in the thesis. For a linear normally resolvable equations in Banach spaces projectors onto kernel and cokernel of operator have been constructed. Neumann series method is generalized on the case of equations with nonexpansive operator. Necessary and sufficient conditions of the solvability of weakly nonlinear equations in the Frechet, Banach and Hilbert spaces have been obtained. Iterative processes of constructing of solutions are proposed. It should be noted investigations of periodic and two multi-point boundary value problems for the operator-differential Hill and Schrodinger equations in the Hilbert space, problems with delay, brusselator models, queuing systems, which are described by the Kolmogorov-Chapman equations, implicit function theorems with converging algorithms, Van der Pol equations in the Hilbert space, controllability of the Sobolev-Galpern's equation in the Hilbert space, Lyapunov and Riccati boundary-value problems.

Summary of PhD dissertation

The dissertation is devoted to obtaining conditions for the existence of solutions bounded on the whole axis R of linear nonhomogeneous, weakly perturbed linear and nonlinear differential equations in Banach space with bounded linear part. Conditions for the existence of solutions bounded on the whole axis R are obtained for a linear nonhomogeneous differential equation under the assumption that the corresponding homogeneous equation has an exponential dichotomy on both semi-axes R_- and R_+. Bounded solutions of equations can be found using the theory of pseudo-inverse operators by means of generalized Green's operator.

Converging iterative algorithms for finding of bounded on the whole axis solutions of weakly nonlinear differential equations in Banach spaces were proposed. This theory also works for partial differential equations.

h-index Web of Science – 4, citations – 47, h-index Scopus – 4, citations – 67,
h-index Google Scholar – 11, citations – 368, h-index mathscinet — 5, citations — 108.

Experience

Developer experience:

2019-2023, Python/Matlab Software Engineer. Deep knowledge in applied mathematics, mathematical statistics, analytics. Simulation of the simplest neural networks and predictions models. Developed and implemented AI and machine learning algorithms to solve complex business problems.Utilized statistical natural language processing to mine unstructured data and create insights. Predicted and modeled neural network behaviours. Used predictive modeling to increaseand optimize customer experiences, revenue generation, ad targeting and other business outcomes. Implemented machine learning algorithms into services and pipelines to implement at scale.Worked closely with the data engineering team to strategize and execute the development of data insight. Conducted rigorous research on the application of AI in the field of differential equations. Collaborated with cross-functional teams to develop innovative AI models. Presented research findings at various conferences and seminars to contribute to the global understanding of AI and its applications.

Research experience:

Leading Jan 2022-, a laboratory of boundary value problems of differential
research equations theory of department of differential equations and oscillation theory,
assistant Institute of Mathematics of National Academy of Science, Kiev, Ukraine

Senior March 2014-Jan 2022, a laboratory of boundary value problems of differential
research equations theory of department of differential equations and oscillation theory,
assistant Institute of Mathematics of National Academy of Science, Kiev, Ukraine

Research Apr 2011-March 2014, a laboratory of boundary value problems of differential
assistant equations theory of department of differential equations and oscillation theory
Institute of Mathematics of National Academy of Science, Kiev, Ukraine

Junior Oct 2009-Apr 2011, a laboratory of boundary value problems of
research differential equations theory of department of differential equations
assistant and oscillation theory, Institute of Mathematics of National Academy
of Science, Kiev, Ukraine

Teachnig experience:

Institute of mathematics of NAS of Ukraine

Special courses for graduate students

2019-, Boundary-value problems for the operator-differential equations
2019-, Geometric dynamics of systems with discrete time

Data school

2018-2019, Mathematics for data scientists, Mathematics Pro

Taras Shevchenko National University of Kyiv

Faculty of cybernetics and computer science

2024, Adaptive information processing and recognition
2024, Fundamentals of control theory and robotics
2023, Differential equations (lectures and practical training)
2023, Controllability of dynamical systems (practical training)

Faculty of mechanics and mathematics

2023, Game theory and economic equilibrium

Faculty of mechanics and mathematics

2016, Macroeconomic models
2016, Game theory and economic equilibrium

Faculty of information technology

2015-2016, Numerical methods (lectures and practical training)
2015-2016, Mathematical analysis (calculus) (lectures and practical training)
2015-2016, Linear algebra and analytical geometry (lectures and practical training)

Chemical faculty

2009, Algebra

Faculty of cybernetics and computer sciences

2008 - 2009, Calculus (practical training)
2007, Numerical methods of mathematical physics (practical training)
2007, Numerical methods of applied mathematics (practical training)

State Institute of Telecommunications

2015, Probability theory and mathematical statistics

Lyceum 241

2007-2017, preparation for the olympiads and scientific works for children
2010-2011, teacher of mathematics (11 class)

Gymnasium 63

2010-2011, scientific works for children

Courses

2010-2011, preparation for an independent testing (phirm Prophi)

Lyceum in Boyarka

2004-2005, preparation for the olympiads

Other relevant information:

2024-2025,   *support of the Simon's foundation for young scientists*

2022-2023,   *support of the Simon's foundation for young scientists*

2020,   *nominal scholarships of the Verkhovna Rada of Ukraine for the most talented young scientists in 2020*

2019,   *Grant of the President of Ukraine*, project: Constructive methods for boundary value analysis and recovery functions

2019,   *Grant of the President of Ukraine for young scientists*, Investigation of natural processes that are modeled by evolutionary boundary-value problems

2019,   *nominal scholarships of the Verkhovna Rada of Ukraine for the most talented young scientists in 2019*

2018-2019,   *competition for winning Grants of the NAS of Ukraine Research laboratories / groups of young scientists of the National Academy of Sciences Ukraine to conduct research on priority directions of development of science and technology*

2018,   *nominal scholarships of the Verkhovna Rada of Ukraine for the most talented young scientists in 2018*

2018,   *The winner of the grant for the visits of young scientists of the National Academy of Sciences of Ukraine for a month to Poland for the purpose of studying at research institutes of the Polish Academy of Sciences*

2017,   *additional departmental theme for young scientists* (project No. 0117U002688)

2016,   *award winner of the Verkhovna Rada of Ukraine for the most talented scientists in the field of basic and applied research and scientific and technological development*

2016,   *Award of National Academy of sciences of Ukraine*: talent, inspiration, work

2015-2016,   *research project of NAS of Ukraine for young scientists*

2014-2015,   *Stipend of President of Ukraine for young scientists*

2014,   *Premium of President of Ukraine for young scientists*

2008,   *Grant of the Slovak Republic*: National Scholarship Programme *of the Slovak Republic*, Zilina University

2006,   *Taras Schevchenko's prize of Kiev National Taras Shevchenko University for the best student's scientific work*, Kiev, Ukraine

2005-2006   *Winner of the whole-Ukrainian student's competition of research work in the direction of Mathematical Sciences*, Donetsk, Ukraine

2001,   *Winner of the whole-Ukrainian universiade: Intellectual of the twenty first century*, Kiev, Ukraine

Research projects:

1. Boundary-value problems and impulsive perturbations of nonlinear evolution equations in infinite-dimensional spaces, 2022-2023
   (Department of targeted of the Shevchenko University, Heads of the project: academician of NAS of Ukraine, Perestyk M.O., member correspondent of NAS of Ukraine, Boichuk A.A.)

2. NRFU Competition Leading and Young Scientists Research Support: Complex dynamical systems in the sciences: theory, mathematical modelling, computing and application to advanced technology, 2020-2022 (Head of the project: academician of NAS of Ukraine, Timokha O.M.).

3. VolkswagenStiftung project: From Modeling and Analysis to Approximations,
   https://www.math.uni-luebeck.de/mitarbeiter/prestin/
   Trilateral_Partnership_202022/index.php#Partner, 2020-2022.

4. Spectral Optimization: From Mathematics to Physics and Advanced Technology (SOMPATY), European Union's 2 Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement, No. 873071, 2020-2024.

5. **Head of the project:**
   Analysis of boundary-value problems in models of natural sciences, 2021-2022.

6. **Head of the project:**
   Investigation of natural processes that are modeled by evolutionary boundary-value problems, 2019-2020.

7. Constructive methods for boundary value analysis and recovery functions", 2019-2020.

8. **Head of the project:**
   Evolution boundary value problems and approximative properties of functional sets and its applications, 2018-2019

9. **Head of the project:**
   Development of solvability methods of boundary value problems for evolution equations which simulate physical, technical and biological problems (additional departmenta theme for young scientists (project № 0117U002688), 2017).

10. **Head of the project:**
    Development of solvability methods of boundary value problems for operator-differential equations which simulate physical, technical and biological problems (in the framework of research projects of NAS of Ukraine for young scientists, 2015-2016)

11. Existence of bounded solutions of differential equations in Banach space
    (in the framework of grant of the Solvak Republic, 2008)

Research Interests:

Differential equations:

Linear and nonlinear boundary value problems for differential and difference equations in Banach and locally convex spaces (exponential dichotomy and bounded solutions), nonlinear oscillations, impulse systems, game theory, operator-differential equations with bounded and unbounded operator coefficients, Schredinger equation, van der Pol equation, Navier-Stokes equations, Palmer's lemma

Mathematical modeling and computational methods:

Development of solvability methods of boundary value problems for operator-differential equations which simulate physical, technical and biological problems (generalized like a Lotka-Volterra models); mathematical simulation of chemical processes (autocatalytic and kinetic reactions), machine learning, deep learning, irreversible processes

Applied functional analysis and dynamical systems:

a priori estimates for operator-differential equations, an operator theory, differential equations with delay, theory of semigroups, dynamical systems and ergodic theory, Moore-Penrose pseudoinverse operators, chaos

Optimization:

controllability of differential equations, Hamiltonian systems, Riccati equation, twentieth problem of Hilbert, interconnected systems, inpute-to-state stability

Information systems and neural networks:

simulation of neural networks using boundary value problems for the van der Pol equation in the Hilbert space, Kolmogorov-Piskunov equation, diffusion processes, using of solvability methods of boundary value problems for evolution equations in the study of neural networks as tools of information systems, Hopfield networks, Cohen-Grossberg networks

Collaboration:

Mesiats Oleksandr
Visit to the United States of America
(New York University of Courant, 2015 year)

Vadim Kaloshin
Visit to the United States of America
(university of Maryland, 2014, 2015 years)

Pereverzev Sergey
Visit to the Austria
(RICAM, Linz, 2018)

Referee for journals:

Differential equations and dynimcal systems, Acta mathematica universitatis comeniane, Ukrainian mathematical journal, Journal of mathematical sciences (Neliniini kolyvannya), methods of functional analysis and topology, Nonlinear dynamics

Approbation of results:
- RICAM : Generalized ill posed problems (Austria, Linz, 2018, chief – Pereverzev Sergiy);
- Humboldt Kolleg: Education and science and their role in social and industrial progress of society (Kiev, 2014);
- Third conference: Mathematics for life sciences (Rivne, 2015);
- Seminars of functional analysis (chief – member correspondent of NAS of Ukraine – Gorbachuk M.L.) (2011, 2013);
- department of mathematics of KAU of the Institute of mathematics of NAS of Ukraine (2016);
- Presidium of NAS of Ukraine (2016);
- Bureau of the department of mathematics of the presidium of the NAS of Ukraine (2016 p.);
- seminar of the department of differential equations and oscillations theory of the Institute of mathematics of NAS of Ukraine (chief – academist of NAS of Ukraine, Samoilenko A. M.) (2016);

- Meetings of the Academic Council of the Institute of Mathematics of the National Academy of Sciences of Ukraine (2015, 2016).

Programming experience: Python, Matlab

Books:

Book for students:

Pokutnyi O.O., Semenov V.V. *Theory of operator equations (additional parts).* – K.:Kiev university, 2017. – 137 p.

Monograph:

Boichuk A.A., Pokutnyi A.A. *Normally-resolvable boundary-value problems for the operator-differential equations.* – K.: Kiev, Naukova dumka, 2022. – 222 p.

Collective monograph (III parts: 1. General and specific problems of complex dynamical systems, 2. Continuum media modeling, 3. Auxiliary problems of complex dynamical systems), 2024, Springer (accepted).

PhD students: Bihun D.S., Iskra O.Z.

Internships:

Zilina Unniversity, Slovac Republic, 01.01.2008 – 01.06.2008, 5 months
University of Maryland, USA, 17.08.2014 – 25.08.2014, 1 week
University of Maryland, USA, 17.10.2015 – 12.11.2015, 1 month
Institute of mathematics PAN, Poland, International mathematical Banach centre, Warszaw, 25.06.2018 – 22.07.2018, 1 month
International mathematical centre, Poland, Bendlewo, 22.07.2018 – 20.10.2018, 1 week
RICAM, Austria, Linz, 01.09.2018 – 20.10.20180, 1.5. months

Summer schools:

ICMU – International center for mathematics in Ukraine, July 29 – August 7, 2024, ATA XVI: Sub-Riemannian geometry and optimal transport, https://mathcentre.in.ua/en/events/ata-2024-sub-riemannian-geometry-and-optimal-transport

ICMU – International center for mathematics in Ukraine, August 4 – August 10, 2024, Operator algebras, quantum groups and quantum information theory, https://mathcentre.in.ua/en/events/operator-algebras-quantum-groups-and-quantum-information-theory

Selected publications:

1. Roughness of dichotomy for the connected system of operator-differential equations in Banach spaces, with Dashkovskiy S., Slynko V. (accepted in proceedings of the 2024 63rd IEEE Conference on Decision and Control).
2. Pokutnyi O.O. Weakly nonlinear hyperbolic differential equation in Hilbert space, *arxiv.org: 2304.09746,* 2023 (accepted in Topological methods in nonlinear analysis).
3. nu, mu – dichotomy and bounded solutions of differential equations, with Boichuk A.A., Bihun D.S., *Miskolc mathematical notes*, vol. 24 (2023), No.3, p.1223-1334.
4. Complex dynamics of the system of nonlinear difference equations in the Hilbert space, *Electronic Journal of Qualitative theory of differential equations, 2023, No. 44, p.1-12,* https://doi.org/10.14232/ejqtde.2023.1.44.
5. Boundary-value problems for the Lyapunov equation. Part I, with Boichuk A.A., Panasenko E.V., *Ukrainian mathematical journal, 2024, v.76, No 3, p. 1-22.*
6. Boundary-value problems for the Lyapunov equation. Part II, with Boichuk A.A., Panasenko E.V., *Ukrainian mathematical journal, 2024, v.76, No 5, p. 1-16.*
7. Autonomous nonlinear boundary value problems for the Lyapunov equation in the Hilbert space, with Bihun D.S, Panasenko E.V., *Ukrainian mathematical journal, 2021, v.73, №7, p. 867 – 878.*
8. Minimizing of the quadratic functional on Hopfield networks, with Boichuk A., Feruk V., Bihun D., *Electronic Journal of Qualitatuve Theory of Differential Equations, 2021, No.92, p.1-20,* https://doi.org/10.14232/ejqtde.2021.1.92.
9. Homoclinic chaos and Navier-Stokes equation, *Mathematical and computer modeling, 2019, 19, p.112-119.*
10. Bifurcation of solutions of the second order boundary value problems in Hilbert spaces, with Boichuk A.A., *Miskolc Mathematical Notes, 2019, No. 1, p.139-152.*
11. Boundary-value problems for the evolutionary Schrodinger equation. Part II, *Nonlinear oscillations (Journal of mathematical sciences), 2019, 22, No.4, p. 439-457.*
12. Boundary value problems for the evolution Schrodinger equation. Part I, *Nonlinear oscillations (Journal of mathematical sciences), 2019, 22, No.2, p.235-249.*
11. Bounded solutions of nonlinear Lyapunov equation and homoclinic chaos, with Boichuk O.A., *Ukrainian mathematical journal, 2019, 71, v.6, p. 761-773.*
12. Perturbation theory of operator equations in the Frechet and Hilbert spaces, with Boichuk A.A. *Ukrainian mathematical journal (in Russian), 2015 (67), 9, p. 1181-1188.*
13. Solutions of the Schrodinger equation in a Hilbert space, with Boichuk A.A. *Boundary Value Problems, 2014, http: // www. boundaryvalueproblems.com/content/2014/1/4*
14. Representation of solutions of boundary value problems for the Schrodinger equation in the Hilbert space. *Nonlinear oscillations, 2014 (17), 1, p. 102-111.*
15. Application of perturbation theory to the solvability analysis of differential algebraic equations, with A. A. Boichuk, V. F. Chistyakov. *Computational Mathematics and Mathematical Physics, 2013 (53), 6, p. 777 – 788.*
16. Bounded solutions of linear and weakly nonlinear differential equations in Banach space with unbounded linear part. *Differential equations, 2012 (48), 6, p. 803 – 813.*

17. Periodic problems of difference equations and Ergodic Theory, with Biletskyi B.A., Boichuk A.A. *Abstract and Applied Analysis, 2011*[http://www.hindawi.com/journals/aaa/aip/928587/.](http://www.hindawi.com/journals/aaa/aip/928587/)

Languages:

Ukrainian, Russian, English, German (basic level)

Hobbies:

Swimming pool, piano, accordion, bayan, guitar, flute