name of the unit:

DIFFERENTIAL EQUATIONS

Institute of Mathematics, Lodz University of Technology

symbol:

I-73

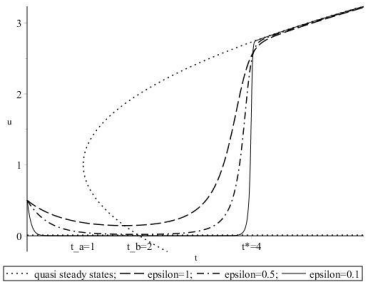
http://www.im.p.lodz.pl

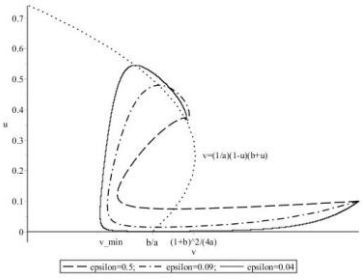
head of the unit:	potential supervisors:	contact person:
dr hab. Katarzyna Szymańska-Dębowska	prof. dr hab. inż. Jacek Banasiak dr hab. Marek Galewski prof. dr hab. Wojciech Kryszewski prof. dr hab. Urszula Ledzewicz dr hab. Katarzyna Szymańska-Dębowska	marek.galewski@p.lodz.pl

scope of activities:

Main areas of interest and directions of scientific research: differential equations, topological methods, nonlinear analysis, dynamical systems, applications of differential equations

graphic material





present activities:

Our research concerns the broadly understood theory of evolutionary processes occurring in exact and natural sciences. This includes analysis of stationary states of these processes, controlling them and optimizing using various quality criteria. Such problems are generally described by ordinary or partial differential equations, functional differential equations, integral equations, and difference equations (for discrete processes) under the presence of local or non-local boundary conditions. We are interested in fundamental problems in functional analysis, operator theory, operator semigroup theory, calculus of variations and variational methods, theory of dynamical systems, fixed point theory and topology. In particular, our research pertains to questions of existence, multiplicity, structure, asymptotic behaviour and stability of solutions, and other qualitative problems. We are also interested in the applications and quantitative aspects of the models. Specifically, we model and study dynamical processes in medicine (e.g., epidemiological and transmission models, drug therapy models) and in biology (e.g., the description of fragmentation, coagulation, population and ecological processes)..

Future activities:

Continuation of the conducted research, extending the scope of the studied problems.

Publications/patents, awards, projects:

Monographs

1. Analytic Methods for Coagulation-Fragmentation Models, series Chapman & Hall/CRC Monographs and Research Notes in Mathematics, CRC Press (Taylor &Francis Group, 2019).

Articles

1. J. Banasiak i A. Błoch, Telegraph systems on networks and port-Hamiltonians. II. Network realizability, Networks & Heterogeneous Media, Vol. 17, 2022, 73-99, DOI: 10.3934/nhm.2021024,

2. W.A. Woldegerima, R. Ouifki i J. Banasiak, Mathematical analysis of the impact of transmission-blocking drugs on the population dynamics of malaria, Applied Mathematics and Computation, tom 400, 2021, Article number 126005, DOI 10.1016/j.amc.2021.126005,

3. J. Banasiak i W. Lamb, Growth-fragmentation-coagulation equations with unbounded coagulation kernels, Phil. Trans. R. Soc. A 378: 20190612, DOI 10.1098/rsta.2019.06122020,

4. J. Banasiak, M.S. Seuneu Tchamga i K. Szymańska-Dębowska, Canard solutions in equations with backward bifurcations of the quasi-steady state manifold, Journal of Mathematical Analysis and Applications, 2019, 471(1-2), pp. 776-795,

5. G. A. Ngwa, M. I.Teboh-Ewungkem, Y.Dumont, R. Ouifki i J. Banasiak, On a three-stage structured model for the dynamics of malaria transmission with human treatment, adult vector demographics and one aquatic stage, Journal of Theoretical Biology, 481(7-8), 2019, 202-222, DOI 10.1016/j.jtbi.2018.12.043,

6. J. Banasiak, L. Joel i S. Shindin, Discrete growth-decay-fragmentation equation: well-posedness and long term dynamics, Journal of Evolution Equations, 2019, 19, 771–802, DOI 10.1007/s00028-019-00499-4,

7. U. Ledzewicz, H. Schättler, On the Role of Pharmacometrics in Mathematical Models for Cancer Treatments, Discrete and Continuous Dynamical Systems - Series B, 26(1), pp. 483-499, 2021, DOI: 10.3934/dcdsb.20202213 (2021),

8. U. Ledzewicz, H. Schättler, On the Role of the Objective in the Optimization of Compartmental Models for Biomedical Therapies, Journal of Optimization Theory and Applications (JOTA), 87, pp. 305-335, 2020.

9. M. Leszczynski, U. Ledzewicz, H. Schaettler, "Optimal Control for a Mathematical Model for Anti-Angiogenic Treatment with Michaelis Menten Pharmacodynamics" Discrete and Continuous Dynamical Systems, Series B, 24 (5), pp.2315-2334, 2019.

10. H. Moore, L. Strauss and U. Ledzewicz, Optimization of Combination Therapy for Chronic Myeloid Leukemia with Dosing Constraints, Journal of Mathematical Biology, 77(5), pp.1533-1561, 2018, doi: 10.1007/s00285-018-1262-6.

11. U. Ledzewicz, S. Wang, H. Schaettler, N. André, A.M. Heng and E. Pasquier, On Drug Resistance and Metronomic Chemotherapy: A Mathematical Modeling and Optimal Control Approach, Mathematical Biosciences and Engineering (MBE), 14(1), pp. 217-235, 2017, doi:10.3934/mbe.2017014.

12. Ćwiszewski A., Gabor G., Kryszewski W., *Invariance and strict invariance for nonlinear evolution problems with applications*, Nonlinear Analysis, Theory, Methods and Applications (140 pkt.), 218, art. 112756 (2022);

13. Kryszewski, W., Siemianowski, J., *Constrined semilinear elliptic systems on R N* , Advances in Differential Equations, 2021, 26(9-10), pp. 459–504

14. Kryszewski, W., Maciejewski, M., *Degree for weakly upper semicontinuous perturbationsof quasi-m-accretive operators: Perturbations of accretive operators*, Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 2021, 379 (2191).

16. Ćwiszewski A., Kryszewski W., *Bifurcation from infinity for elliptic problems on R^N* Calc. Var. and Part. Diff. Eq. 2019-02

17 . Kryszewski W., Siemianowski J.,*The Bolzano mean-value theorem and partial differential equations*. J. Math. Anal. Appl., Vol. 457 (2018)

18. Michał Bełdzinski, Marek Galewski, Igor Kossowski, Dependence on parameters for nonlinear equations—Abstract principles and applications, Mathematical Methods in the Applied Sciences, 45 (3) (2022), 1668–1686

19. Marek Galewski, On variational nonlinear equations with monotone operators, Advances in Nonlinear AnalysiS, 10 (2021), 289–300, doi.org/10.1515/anona-2020-0102

20. Michał Bełdzinski, Marek Galewski, Nash–type equilibria for systems of non-potential equations, Applied Mathematics and Computation, vol.385 (2020)

21. Jean Mawhin, Ewa Skrzypek, Katarzyna Szymańska-Dębowska, Du Bois–Reymond Type Lemma and Its Application to Dirichlet Problem with the p(t)–Laplacian on a Bounded Time Scale, Entropy, 23 (10), 1352, 21 pp.

22. Marek Matyjasik, Katarzyna Szymańska-Dębowska, Solvability for nonlocal boundary value problems with generalized p-Laplacian on an unbounded domain, Forum Mathematicum, 33 (5) (2021), 1321-1330

23. Katarzyna Szymańska-Dębowska, Mirosława Zima, A topological degree approach to a nonlocal Neumann problem for a system at resonance, Journal of Fixed Point Theory and Applications, 21 (2) (2019), 1-14

24. Jean Mawhin, Katarzyna Szymańska-Dębowska, Convexity, topology and nonlinear differential systems with nonlocal boundary conditions: a survey, Rend. Istit. Mat. Univ. Trieste, 51 (2019), 125–166

Project: NCN OPUS 'Mathematics of multiscale models in life and social sciences', Jacek Banasiak (PI)
Project: NCN MINIATURA 2, 2018/02/X/ST1/02082, Katarzyna Szymańska-Dębowska

Project: NCN OPUS 2013/09/B/ST1/01963 "Topological methods in the study of dynamics of nonlinear evolution equations", Wojciech Kryszewski (leader)

Keywords:

differential equations, topological methods, nonlinear analysis, dynamical systems, applications of differential equations, integro-differential equations, mathematical epidemiogy

List of internship proposal in this research team:

Scientific cooperation in a selected area of research or related topics.