Annotation (abstracts)
of the scientific works
for participation in the competition
of Kremena Stefanova, PhD

For the current competition (see List of the scientific works for participation in the competition) are selected 18 works which include 14 papers, 3 books, and 1 textbook.

Scientific field A. Computer modelling of discrete neural networks	
[1]	**K. Stefanova, S. Hristova and A. Golev, Dynamic modeling of discrete leader-following consensus with impulses,** ***AIMS Mathematics*****, 2019, 4(5): 1386-1402. doi: 10.3934/math.2019.5.1386, ISSN (Online): 2473-6988.** **Metrics: SJR 2019: 0.458, JIF: 0.882, Q3 Appl. Math., Q2 Math.**
	Abstract. A discrete model of a multi-agent system with a virtual leader, whose motion is independent of all the other agents, is studied. It is modeled the case when at initially known time-points the interactions between multi-agents are changed instantaneously. We consider the case of two interacting topologies, one is determined by the interactions between the agents including the leader, and the second one is determined by the instantaneous switching interactions of the agents with the leader. Several sufficient conditions ensuring both local and global leader-following consensus are obtained. These results are illustrated on particular examples by intensive application of computer simulation by the programming language C++. The application of the programing codes and the computer results give us the opportunities to demonstrate practically the influence of the impulses on the behavior of the followers with small jumps as well as with at least one large jump. They also show the necessity of small Lipschitz constant at the activation functions.
[2]	**K. Stefanova, S. Hristova and A. Golev, Discrete leader-following consensus for multi-agent system with non-instantaneous impulses,** ***Dynamic Systems and Applications*****, Vol. 28, No. 3, 2019, 743-755, ISSN: 1056-2176, doi: 10.12732/dsa.v28i3.12, <u>Journal Impact Factor:</u> 0.359 (2017); 0.362 (5 years).** **Metrics: SJR 2019: 0.208, JIF: 0.522, Q4 Appl. Math., Q4 Math.**
	Abstract. The main purpose of this paper is to study a discrete-time multi-agent system consisting of agents and the leader. For the first time it is studied the case when the control protocol is based on two interaction topologies. The first interaction topology is modeling the interactions between all agents including the leader. The second one is connecting only with the intervals on which any agent is interacting only with the leader, i.e. in the so-called intervals of non-instantaneous impulses. Sufficient conditions ensuring a leader-following consensus are obtained. Several examples are solved by computer realization to illustrate effectiveness of the obtained theoretical results. The programming language C# is used to calculate the values of state trajectories of all agents. By example, the necessity and sufficiency of the obtained conditions are shown.

[3]	**Snezhana Hristova, Kremena Stefanova, Exponential stability of Hopfield-type delay impulsive discrete neural networks and computer simulation, *International Journal of Differential Equations and Applications*, Vol. 19, No. 1, 2020, 33-44, ISSN (Online): 1314-6084, 10.12732/ijdea.v19i1.3** **Metrics: Zentralblatt**
	Abstract. In the paper a discrete Hopfield-type neural network with constant delays, instantaneous switching topologies at certain times and time variable connection weights is studied. Some criteria for exponential stability are derived. The obtained results are illustrated on an example and it is paid attention to different activation functions such as tanh, Swish, and the error function. The example is computer realized by the help of Wolfram Mathematica. Following the theoretical schemes for solving the problems, the corresponding algorithms are coded to calculate the values of the solution for each step and to confirm the correctness of the formulated criteria.
[4]	**Snezhana Hristova, Kremena Stefanova, Exponential stability of discrete neural networks with non-instantaneous impulses, delays and variable connection weights with computer simulation, *International Journal of Applied Mathematics*, 2020, Vol. 33, No. 2, 187-209, ISSN: 1311-1728, DOI: 10.12732/ijam.v33i2.1.** **Metrics: SJR 2019: 0.271**
	Abstract. The exponential stability concept for nonlinear non-instantaneous impulsive difference equations with a single delay is studied and some criteria are derived. These results are also applied for a neural networks with switching topology at certain moments and long time lasting impulses. It is considered the general case of time varying connection weights. The equilibrium is defined and exponential stability is studied. The meaning and usefulness of the definition of the equilibrium point is discussed and illustrated. Also, several discrete neural networks are considered and the theoretical results are applied. The examples are computer realized by the help of Wolfram Mathematica. The theoretically grounded algorithms are coded and then the values of the solutions for each step are calculated. Based on the computer simulations, conclusions about the behavior of the agents in the model are made.
[5]	**Kremena Stefanova, Computer simulations for delay impulsive discrete neural networks, International *Journal of Differential Equations and Application*s, Vol. 19, No. 1, 2020, 63-82, ISSN (Online): 1314-6084.** **Metrics: Zentralblatt**
	Abstract. The paper is focused on a discrete Hopfield-type neural network with constant delays, instantaneous switching topologies at certain times and time variable connection weights is studied. Several models for the neural network are considered to illustrate the influence of different factors on the behavior of the solutions. These factors include the initial conditions, the impulsive conditions, the activation functions and the number of agents in the network. Following the appropriate theoretical schemes for solving the problems, the corresponding algorithms are coded by the help of Wolfram Mathematica to calculate the values of the solutions. Based on the obtained values and generated graphs, the required conclusions are made.

[6]	**Monograph** **Hristova, S. and K. Stefanova, Stability properties of neural networks. Theoretical study and computer simulations, LAP LAMBERT Academic Publishing, 2020, ISBN: 978-620-2-66658-9.**
	Abstract. The book presents conducted theoretical studied about neural networks, which are combined practically with computer simulations. It is given several discrete models such as, Hopfield-type delay impulsive neural networks, neural networks with non-instantaneous impulses and delays, and several continuous neural networks with switching topologies at impulsive times both deterministic as well as random. It is discussed various types of stability properties of the considered models. Also, it is presented and studied the leader-following consensus problem for discrete multi-agent system with non-instantaneous impulses. Most of the theoretical results are practically applied to certain examples with computer simulations. The study in the book is connected with extensive interests in recent years in connection with the potential applications of neural networks in various fields such as signal processing, pattern recognition, combinatorial optimization and many other. It required the definitions and study of various types of models, which can more adequate describe the behavior in the multi-agent systems.
Scientific field B. Computer application of iterative methods for fractional differential equations	
[7]	**R. Agarwal, A. Golev, S. Hristova, D. O'Regan, K. Stefanova, <u>Iterative techniques with computer realization for the initial value problem for Caputo fractional differential equations</u>, *Journal of Applied Mathematics and Computing*, 2018, 58: issue 1-2, 443-467, Online ISSN: 1865-2085, Print ISSN: 1598-5865, (Impact factor: 1.370), <u>https://doi.org/10.1007/s12190-017-1152-x</u>.** **Metrics: SJR 2018: 0.456, JIF 2019: 1.242, Q2 Appl. Math, Q1 Math.**
	Abstract. The main aim of the paper is to suggest some algorithms and to use them in an appropriate computer environment to solve approximately the initial value problem for scalar nonlinear Caputo fractional differential equations on a finite interval. Some iterative techniques combined with the method of lower and upper solutions are applied to find the approximate solution of the given problem. Several algorithms for constructing two convergent monotone functional sequences are given and we prove both sequences converge and their limits are minimal and maximal solutions of the problem. When the right hand side of the equations are monotone functions with respect to the time variable the elements of these sequences do not depend on the Mittag-Leffler functions and they can be obtained in closed form with the help of an appropriate software such as Wolfram Mathematica. In the general case, the elements of these sequences are obtained with an integral containing the Mittag-Leffler function with two parameters so as a result finding successive approximations can be difficult in practice. The practical application of the proposed schemes is illustrated by examples. A special computer program based on the C # programming language has been created for their numerical solving. The calculated values of the approximations are presented in tables and graphs, and conclusions are made.
[8]	**R. Agarwal, A. Golev, S. Hristova, D. O'Regan, K Stefanova, <u>Iterative Techniques with Initial Time Difference and Computer Realization for the Initial Value Problem for Caputo Fractional Differential Equations</u>, *Memoirs***

	***on Differential Equations and Mathematical Physics*, Volume 72, 2017, (Impact factor: 0.180), 1–14.** **Metrics: SJR 2017: 0.269**
	Abstract. In this paper an initial value problem for scalar nonlinear Caputo fractional differential equations on a finite interval is presented. The possible cases for mild upper and lower solutions of the given problem are studied, which are defined on different time intervals. Respectively, some algorithms for constructing sequences of successive approximations are suggested to solve approximately the problem. They do not use Mittag–Leffler functions and as a result, the practical application of the algorithms is easier. Several particular initial value problems for Caputo fractional differential equations are given to illustrate the advantages of the iterative techniques with initial time difference. They are numerically solved by an appropriate computer environment.
[9]	**Golev, A., A. Penev, K. Stefanova and S. Hristova, Using GPU to Speed Up Calculation of Some Approximate Methods for Fractional Differential Equations, *International Journal of Pure and Applied Mathematics*, Vol. 119, No. 3, 391-401, 2018, ISSN 1311-8080 (printed version), ISSN 1314-3395 (on-line version).** **Metrics: SJR 2018: 0.127**
	Abstract. The main aim of the paper is comparing the speed of calculation for a particular initial value problem for scalar nonlinear Riemann-Liouville fractional differential equation by parallel CUDA cores. The approximate solving is based on a suggested iterative scheme for constructing sequences of upper and lower solutions of the considered problem. In the general case, the elements of these sequences are obtained by an integral containing the Mittag-Leffler function. It can cause the successive approximations to be difficult for practical applications. The computer program using the parallel calculations is built and applied to approximately solve an initial value problem for scalar nonlinear Riemann-Liouville fractional differential equation. Using the parallel CUDA cores, the computations are about 10 times faster than the consecutive computations.
[10]	**Snezhana Hristova, Kremena Stefanova and Angel Golev, Computer Simulation and Iterative Algorithm for Approximate Solving of Initial Value Problem for Riemann-Liouville Fractional Delay Differential Equations, *Mathematics*, 2020, 8(4), 477, ISSN 2227-7390, (Impact Factor 2019: 1.747), https://doi.org/10.3390/math8040477 - 01 Apr 2020** **Metrics: SJR 2019: 0.299, JIF: 1.747, Q1 Math.**
	Abstract. The main aim of this paper is to suggest an algorithm for constructing two monotone sequences of mild lower and upper solutions, which are convergent to the mild solution of the initial value problem for Riemann-Liouville fractional delay differential equation. The algorithm is based on a monotone iterative technique. By the programming language C# the iterative scheme is computerized and applied to solve approximately an initial value problem for scalar nonlinear Riemann-Liouville fractional differential equations with a constant delay on a finite interval. By the help of the calculated values of the approximations and the generated graphs is shown the practical application of the obtained theoretical results.

[11]	**Agarwal, R.; Hristova, S.; O'Regan, D.; Stefanova, K. Iterative Algorithm for Solving Scalar Fractional Differential Equations with Riemann–Liouville Derivative and Supremum, *Algorithms*, 2020, *13*, 184, https://doi.org/10.3390/a13080184.** **Metrics: SJR 2019: 0.358**
	Abstract. The initial value problem for a special type of scalar nonlinear fractional differential equation with a Riemann–Liouville fractional derivative is studied. The main characteristic of the equation is the presence of the supremum of the unknown function over a previous time interval. This type of equation is difficult to be solved explicitly and we need approximate methods for its solving. In this paper, initially, mild lower and mild upper solutions are defined. Then, based on these definitions and the application of the monotone-iterative technique, we present an algorithm for constructing two types of successive approximations. Both sequences are monotonically convergent from above and from below, respectively, to the mild solutions of the given problem. The suggested iterative scheme is computer realizaed in Wolfram Mathematica. The codes are used to solve specific examples. With the help of the computer application not only the correctness of the theoretical results is confirmed, but their practical application for other tasks is possible.
Scientific field C. Computer realization of algorithms for approximate methods for differential and difference equations	
[12]	**S. Hristova, A. Golev, K. Stefanova, Approximate Method for Boundary Value Problems of Anti-Periodic Type for Differential Equations with Maxima, *Boundary Value Problems*, 2013, 2013:12, ISSN: 1687-2770, (Impact Factor: 1.02), doi:10.1186/1687-2770-2013-12.** **Metrics: SJR 2013: 0.709, JIF: 0.836, Q1 Math., Q2 Appl. Math.**
	Abstract. An algorithm for constructing two sequences of successive approximations of a solution of the nonlinear boundary value problem for a nonlinear differential equation with 'maxima' is given. The case of a boundary condition of anti-periodic type is investigated. This algorithm is based on the monotone iterative technique. Two sequences of successive approximations are constructed which are monotonically convergent. Each term of the constructed sequences is a solution of an initial value problem for a linear differential equation with 'maxima' and it is a lower/upper solution of the given problem. A computer implementation of the algorithm for a specific example was performed using the C# programming language. The calculated values of the approximations are presented in a graphical and tabular way, and as a result, conclusions are made.
[13]	**Ravi P. Agarwal, S. Hristova, A. Golev, K. Stefanova, Monotone-iterative method for mixed boundary value problems for generalized difference equations with "maxima", *Journal of Applied Mathematics and Computing*, Journal no. 12190, 2013, DOI: 10.1007/s12190-013-0660-6, Online ISSN: 1865-2085, Print ISSN: 1598-5865.** **Metrics: SJR 2013: 0.438**
	Abstract. In this paper the authors investigate special type of difference equations which involve both delays and the maximum value of the unknown function over a past time interval. This type of equations is used to model a real process which present state depends significantly on its maximal value over a past time interval.

	An appropriate mixed boundary value problem for the given nonlinear difference equation is set up. An algorithm, namely, the monotone iterative technique is suggested to solve this problem approximately. An important feature of our algorithm is that each successive approximation of the unknown solution is equal to the unique solution of an appropriately constructed initial value problem for a linear difference equation with “maxima”, and a formula for its explicit form is given. Also, each approximation is a lower/upper solution of the given nonlinear boundary value problem. By a successfully combination between the proved theoretical results and programming, this iterative scheme is coded in C# and used for solving of the consider examples to illustrate the practical application of the algorithm.
[14]	**Monograph** **Golev, A., S. Hristova and K. Stefanova, Approximate methods and computer realization. Differential, difference and fractional differential equations, LAP LAMBERT Academic Publishing, 2018, ISBN: 978-613-9-82004-7.**
	Abtsract. The main aim of the book is to suggest and apply in an appropriate computer environment some approximate methods for solving different types of differential equations such as differential equations with a special type of delay, difference equations and Caputo fractional differential equations. The significant characteristics of these methods is the appropriate obtaining of the exact solution of monotonic sequences of successive approximations. The suggested methods are based on the application of upper and lower solutions to the studied problems. Several algorithms are theoretically proved and practically applied for approximately solving of various types of equations.
Scientific field D. Development of business software applications	
[15]	**Angel Golev, Nikolay Pawlov, Georgi Spasov, Kremena Stefanova, Module for LaTeX Export in the Distributed Platform for E-Learning DisPeL, Proc. of *International Conference „From DELC to VELSPACE“*, Plovdiv, Bulgaria, 26–28 March, 113–120, 2014, ISBN: 0-9545660-2-5.**
	Abstract. Within the distributed e-learning platform (DisPeL) it is created a module for exporting of electronic textbooks used in the system, to LaTeX format. The aim is the preparation of textbooks for printing on paper. The platform has its own editor to input electronic textbooks, which are stored in HTML format with own styles and structures. Corresponding HTML and LaTeX templates are created that describe the structure of the electronic textbook and allow the transfer of the contents of the textbook to LaTeX document.
[16]	**Stoyan Cheresharov, Kremena Stefanova, Ivan Jelev, Veselina Naneva, A Prototype of a System for E-Learning, Proc. of International Conference on Applied Internet and Information Technologies, 3-4 October, 2019 Zrenjanin, Serbia, 10-16, ISBN: 978-86-7672-327-0. Link: http://www.tfzr.rs/aiit/files/AIIT2019_ProceedingsFinal.pdf**
	Abstract. During the rapid development of information technology, the models and techniques of learning undergo daily changes. Each university should provide accurate tools for learning both in the classroom and remotely. There are a large number of websites and platforms that organize the learning process and can be used by both teachers and students. However, the educational process is a closed cycle and it covers the phase of applying to the university, goes through the years of

	studying and ends with the successful career realization of students. If a university wants to use an educational platform, it can implement an existing one or develop its own. Some of the advantages of the custom solution are, for instance, that it satisfies the specific requirements and there is no need of modification. The paper suggests a prototype of an e-learning platform, which can be used in higher education. It supports the communication and the educational process of student and teacher, inside and outside the university. Also, it has a module which is focused on the connection between students and the business representatives.
[17]	**Textbook** **Rahnev, A., K. Stefanova and N. Pavlov, Integration of Business Software Applications, Plovdiv University "Paisii Hilendarski" and WWEDU World Wide Education, Wels, 2013, ISBN 978-3-99034-203-9.**
	Abstract. In today's world, business software applications are constantly evolving. They provide new solutions to help the organizations increase and measure productivity, perform business functions accurately, and gain competitive edge. The challenge for organizations is to speed the deployment of business software applications in order to meet the demands of quickly changing market requirements. This book provides readers with a technical and managerial understanding of the processes of analyzing, developing, implementing, and managing successful business software applications.
Scientific field E. Monograph based on the PhD Thesis	
[18]	**Hristova, S. and K. Stefanova, Differential equations and integral inequalities with "maximum", LAP LAMBERT Academic Publishing, 2018, ISBN: 978-613-9-88102-4.**
	Abstract. The aim of the book is to investigate some integral inequalities and differential equations in the special case when the value of the unknown function is involved not only at the present time but also its maximal value on a past time interval is presented. Initially several types of integral inequalities with "maximum" for continuous and piecewise continuous functions are solved. This helps us to build the mathematical apparatus for qualitative investigation of the behavior of the solutions of differential equations with "maximum". Several types of sufficient conditions for uniqueness, boundedness, continuous dependence on the initial conditions and stability of the solution are obtained.
[19]	**Abstract of a PhD thesis "Qualitative methods for some special types of differential equations", defended on 20.09.2012.**
	Abstract. The results obtained in a PhD thesis on "Qualitative methods for some special types of differential equations" are briefly presented. Three special types of differential equations are investigated: differential equations with "maxima", partial differential equations with "maxima" and impulsive differential equations with "supremum". The unifying characteristic of these equations is the presence of the maximum value of the unknown function over a past time interval. In connection with the above types of equations in the thesis are considered some integral and differential inequalities. Thanks to the extended mathematical apparatus of integral and differential inequalities is complemented the theory of differential equations by investigation of qualitative properties of solutions of differential equations with "maxima" and partial differential equations with "maxima", and providing

	sufficient conditions for uniqueness, boundedness and continuous dependence on the initial conditions of their solutions; extending the concept of practical stability for differential equations with "supremum" and obtaining sufficient conditions for this type of stability; justification of an approximate asymptotic method for solving nonlinear boundary value problems for differential equations with "maxima".

Signature:

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18.08.2020

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