

Opinion

by Assoc. Prof. Ivan Radoslavov Georgiev, PhD

for the dissertation

entitled:

**"Application of cell-neural networks for research
of partial differential equations arising in
financial mathematics".**

author: **Pavel Todorov Stoynov**

for acquiring the educational and scientific degree of PhD

Field of higher education 4. Natural Sciences, Mathematics and Informatics,

Professional direction 4.5 Mathematics,

Scientific subject "Mathematical Modeling and Applications of Mathematics"

By Order No. 88/04.05.2022 of the Director of IMI-BAS I have been appointed as a member of the Jury for the defense of the dissertation of Pavel Todorov Stoynov entitled "Application of cell-neural networks for the study of partial differential equations arising in financial mathematics". The materials necessary for the defense of the dissertation, I received on 13.05.2022 electronically:

1. CV
2. Application for admission to the defence
3. Dissertation - in two files
4. Summarized dissertation
5. List of publications and the publications themselves
6. Reference of the candidate's contributions
7. Reference of citations.

There was some doubt about the authorship of the dissertation as the required citations being not denoted. As a result, an extraordinary meeting of the Jury was held on 8.06.2022 regarding the suspicion of plagiarism in the thesis. It was found that Pavel Stoynov had translated and taken whole passages in the submitted dissertation verbatim from the following 3 books:

- R. Cont, P. Tankov, Financial Modelling with Jump Processes, CRC press Company, 2004
- S. Boyarchenko, S. Levendorskii, Non-Gaussian Merton-Black-Scholes Theory, World Scientific, 2002

- O. Ugur, An Introduction to Computational Finance, Imperial College Press, 2009

These references have not been cited in the presented dissertation and are not included in the bibliography.

The jury unanimously decided that there is plagiarism in the dissertation of Pavel Todorov Stoynov.

I present a brief description of the dissertation and the corresponding submitted publications.

General description of the submitted materials

Pavel Stoynov's dissertation is 156 pages long and contains an introduction, three chapters, a conclusion, a bibliography, author publications on the dissertation, and appendices.

The main focus of the dissertation is on the application of Nonlinear Cellular Neural Networks (CNNs) to the study of nonlinear partial differential equations that arise in financial mathematics. Special attention is paid to the Black-Scholes equation. In general, the nonlinear Black-Scholes equation is too complex and not amenable to analytical study. Due to this, the application of CNN for its numerical study is of interest. This enables the implementation of software products that would have important applications in portfolio construction and risk management in financial markets. The topic is highly relevant and dissertationable in terms of successful portfolio organization in financial markets. For economics and financial mathematics, such concept of dynamic investment decision or dynamic stocks is very important.

Brief description of the chapters in the presented dissertation:

Chapter 1 is entitled "Stochastic processes, stochastic differential equations". A large part of this chapter is based on text that has been taken from the aforementioned books. This text is not cited either in the chapter itself or in the references used.

Chapter 2, entitled "Cellular Neural Networks," discusses the basic types of cellular neural networks and the equations that describe them. Simulations of ST density distribution plots for different cases of CNNs are presented, which are author contributions. No plagiarism was found in Chapter 2 that was not cited in the text or in the references to the thesis.

Chapter 3 is entitled "Using cellular neural networks for approximate solution of integro-differential equations from financial models and partial differential equations in financial mathematics". Here a plagiarism of MATLAB codes from

the following source is found without citation - O. Ugur, An Introduction to Computational Finance, Imperial College Press, 2009 ([https://books.google.bg/books?id=1s42DwAAQBAJ&pg=PA255&lpg=PA255&dq=BlackScholes_CrankNicolson_pSOR\(S0,K,r,D,sigma,T,f,alpha,beta,Smin,Smax,dS,dt,omega,tol\)&source=bl&ots=FHo9h4TDoG&sig=ACfU3U2CS6H9IkcU1BkxgC0A0cANrtDQng&hl=bg&sa=X&ved=2ahUKEwj2n5_Ro-74AhVjX_EDHStWBaUQ6AF6BAgCEAM#v=onepage&q=BlackScholes_CrankNicolson_pSOR\(S0%2CK%2Cr%2CD%2Csigma%2CT%2Cf%2Calpha%2Cbeta%2CSmin%2CSmax%2CdS%2Cdt%2Comega%2Ctol\)&f=false](https://books.google.bg/books?id=1s42DwAAQBAJ&pg=PA255&lpg=PA255&dq=BlackScholes_CrankNicolson_pSOR(S0,K,r,D,sigma,T,f,alpha,beta,Smin,Smax,dS,dt,omega,tol)&source=bl&ots=FHo9h4TDoG&sig=ACfU3U2CS6H9IkcU1BkxgC0A0cANrtDQng&hl=bg&sa=X&ved=2ahUKEwj2n5_Ro-74AhVjX_EDHStWBaUQ6AF6BAgCEAM#v=onepage&q=BlackScholes_CrankNicolson_pSOR(S0%2CK%2Cr%2CD%2Csigma%2CT%2Cf%2Calpha%2Cbeta%2CSmin%2CSmax%2CdS%2Cdt%2Comega%2Ctol)&f=false))

Note to Chapter 3. The same MATLAB codes are visible on the Internet (for example: https://open.iam.metu.edu.tr/images/myWebSiteData/CompFin/mfiles_inBook/showFiles.php?show=BlackScholes_Explicit.m), on different sites. In the appendix of the thesis, where the MATLAB developed codes are given, no citations of internet sources are mentioned.

To the dissertation has been submitted 6 publications, 5 of which are in journals with SJR and 1 is referenced in Zentralblatt fur Mathematik.

With the plagiarism thus established, unfortunately no conclusion can be drawn about the scientific contributions of Pavel Stoynev in his thesis and publications.

Conclusion: The topic of the presented dissertation is extremely trendy and dissertationable. The application of Nonlinear Cellular Neural Networks to the study of nonlinear partial differential equations that arise is of great importance to financial mathematics. In particular for the numerical solution of some complex nonlinear partial differential equations by CNNs. The review process revealed plagiarism of a significant portion of the dissertation text. By Protocol No. 2 of the meeting of the scientific Jury of 8.06.2022 it was decided to terminate the procedure for the defense of the dissertation entitled "Application of cellular-neural networks for the study of partial differential equations arising in financial mathematics" with the author Pavel Todorov Stoynev. In connection with the facts of plagiarism thus established and the decision taken by the scientific Jury, I do not support the acquisition of the degree of Doctor of Education and Science by Pavel Todorov Stoynev in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional direction 4.5 Mathematics, scientific subject "Mathematical Modelling and Application of Mathematics".

Ruse, 6.07.2022

Signature:

Assoc. Prof. Ivan Radoslavov Georgiev, PhD