ATTITUDE OF REVIEWER

by Prof. Dr. Nikolay Vesselinov Kyurkchiev

for the dissertation

on the topic: "APPLICATION OF CELLULAR NEURAL NETWORKS TO THE STUDY OF PARTIAL DIFFERENTIAL EQUATIONS ARISING IN FINANCIAL MATHEMATICS"

with author: PAVEL TODOROV STOYNOV

for awarding the educational and scientific degree "Doctor":

Field of higher education 4. Natural sciences, mathematics and informatics,

Professional direction 4.5. Mathematics,

Doctoral program "Mathematical modeling and applications of mathematics"

By order 88/04.05.2022 of the Director of the Institute of Mathematics and Informatics, I have been appointed as a member of the scientific jury in connection with the procedure for the defense of the dissertation work on the topic "Application of Cellular Neural Networks to The Study of Partial Differential Equations Arising in Financial Mathematics" for acquiring the educational and scientific degree "Doctor" in: field of higher education 4. Natural sciences, mathematics and informatics; professional direction 4.5. Mathematics; doctoral program Mathematical modeling and applications of mathematics" by Pavel Todorov Stoinov.

As a member of the scientific jury, I have received: Professional CV; Order for enrollment in doctoral studies (No. 224/ 12.02.2018); Certificate of passed exams according to the doctorate plan; Order for deduction from doctoral studies (No. 339/ 23.12.2021); List of publications on the topic of the dissertation; Dissertation work; Review of dissertation contributions and publications; Dissertation resume.

1. General characteristics of the dissertation work and materials of the procedure

The presented dissertation work of Pavel Todorov Stoynov has a volume of 155 pages. It consists of an introduction, three chapters and a bibliography of 53 titles. The publications on the dissertation are 6. The total SJR of the publications on the dissertation work is SJR = 0.9 (and is formed by 5 of these publications (indexed in the Web of Science database), which satisfies the scientific-metric criteria from the IMI-BAS Requirements for the application of ZRASRB. The doctoral student presented a reference for three citations of publications related to the dissertational work. Total SJR=0.575 – formed by 2 citations. The obtained results were reported at the international conferences NTADES 2019, NTADES 2020 and NTADES 2021. The topic and content of the dissertation fully correspond to the professional direction and doctoral program.

2. Relevance of the research. Characterization and evaluation of the dissertation work and contributions

The presented thesis is an attempt to assess the state of the art and the possibility of using cellular neural networks for the approximate solution of partial differential equations arising in finance. A classic differential equation in financial mathematics is the Black-

Scholes partial differential equation for share price, the derivation and analysis of which is presented in detail in the work.

Basically, the candidate groups the scientific and applied contributions of the dissertation in the following directions:

- study of Switch-Time (ST) processes of the diffusion type with jumps;
- specific proprietary applications for ST-tempering using ST-distribution;
- the developed general model for solving NSDE arising in finance with the application of cellular neural networks.

The candidate also provides modules implemented in the MATLAB computer algebra system related to the application of cellular neural networks for solving the Black- Scholes equation and evaluating financial derivatives and barrier options.
The topic is actual.

3. Assessment of the publications and personal contribution of the PhD student

One week after the meeting of the SJ to determine reviewers for the procedure, we were informed by the Chairman - Assoc. Dr. Tsv. Zaevski for problematic parts that he found in the dissertation related to obvious plagiarism. As a specialist in the field of Probability Theory, he provided to us with incontrovertible evidence for this claim - about 60 pages of the presented thesis, which use "passages" from 3 books (which are not cited and are missing from the applicant's bibliography), as well as obvious evidence of plagiarism in one of the articles submitted for participation in the procedure. **I have personally verified and support the stated claims!**

In addition, I will explicitly note that a part of the scientific-applied contributions (according to the author's self-assessment, for example in Chapter 1) are subject to serious reflection and re-evaluation. For example – "4. The author's proposal for a spiking diffusion-type process with an asymmetric ST-distribution..." and more precisely the proposed local measure of spiking is based on the very well-known technique used in general for continuous "stitching" by parameter $0< p<1$ on two or more distributions of the same kind.
The frivolous mixing of "borrowed passages" from the mentioned sources has led to a serious inconsistency - a broken parameterization in the considered dynamic models.

It does not become clear, at a later stage – the subject of research in the next chapter of the dissertation, how the desired smoothness of the analytical continuation is achieved when studying ST-nonlinearity in the neuron model.

The presentation of the used activation functions – Logistic, Half-Logistic, Lindley (graphs when parameters vary, etc.) is boring. The presentation of the activation functions used more recently – Kumaraswamy-Lindley, Expo-exponential, Poly and others advocated in the field of financial and insurance mathematics would be more interesting.

I have some reservations about the author's assessment of the applied contributions in the dissertation - MATLAB codes for solving the Black-Scholes equation and option valuations. To the extent that similar modules have been implemented in a number of

computer-algebraic systems for scientific research, the fact that the candidate uses codes proposed by other authors, and not his own development, is puzzling.

The said above gives me reason to do the following

Conclusion: **My assessment of the dissertation work, the abstract, scientific publications and scientific contributions of Pavel Todorov Stoynov is negative.**

I propose to the honorable scientific jury **NOT** to award the educational and scientific degree "**doctor**" to Pavel Todorov Stoynov; professional field "Mathematics"; doctoral program "Mathematical modeling and applications of mathematics".

June 10, 2022   Signature:

/Prof. Nikolay Kyurkchiev, PhD/