

OPINION

by **Professor Leoneed M. Kirilov, PhD**

Inst. of Information and Communication technologies – Bulgarian Academy of
Sciences

on the Thesis for awarding educational and scientific degree “Doctor of Philosophy”
(PhD), under the Scientific field: 4. Natural Sciences, Mathematics and Informatics;
the Professional area: 4.6. Informatics and Computer Sciences, the Doctoral
program: Informatics

Author of the PhD Thesis: Kristel Gjergj Vula

**PhD thesis title: Transformer-Based Detection and Epidemic Model Analysis of
Fake-News Dynamics on Social Networks**

According to the Order No. 177 from June 06, 2026 of the Director of the Institute
of Information and Communication technologies – Bulgarian Academy of Sciences, I
have been appointed as a member of the Scientific Jury regarding the PhD thesis of
Kristel Gjergj Vula for awarding educational and scientific degree “Doctor of
Philosophy” (PhD) in the Scientific field: 4. Natural Sciences, Mathematics and
Informatics; the Professional area: 4.6. Informatics and Computer Sciences, the
Doctoral program: Informatics.

At the first meeting of the Scientific Jury on June 30, 2026, it was decided that I
would write an opinion on the dissertation.

As a member of the Scientific Jury I have received:

1. Text of the Thesis for awarding educational and scientific degree “Doctor of
Philosophy” in English

2. Abstract of the Thesis in English and Bulgarian
3. Signed declaration of originality in English
4. List of published scientific publications on the topic of the dissertation
5. Full text of the articles attached to the dissertation as an integral part of it in accordance with the requirements of ZRASRB and the Regulations for its implementation - five articles
6. A reference for Kristel Gjergj Vula on fulfillment of the minimum requirements of the Institute of Information and Communication Technologies - BAS for awarding the educational and scientific degree "Doctor"
7. A reference for Kristel Gjergj Vula on fulfillment of the minimum national requirements for awarding the educational and scientific degree "Doctor"
8. Order No. 138 from May 29, 2026 issued by IICT – BAS for withdrawing Kristel Gjergj Vula from part-time doctoral studies with right up for grant PhD degree when the Thesis is ready within a legal deadline
9. A file in pdf format of a full report from the examination of the dissertation work with a licensed plagiarism checking system (Strike Plagiarism, iThenticate or equivalent)
10. Order No. 177 from June 06, 2026 issued by IICT – BAS for designation of Scientific Jury.

Scientific advisor of the PhD student is Prof. Dr. Vassil Georgiev Guliashki.

The dissertation is written on 210 pages and it consists of introduction, three chapters, conclusion, thesis contributions, declaration of originality, bibliography (it contains 191 references), eight appendices (totaling 45 pages). The text is illustrated with 46 figures and 111 tables.

The objective of the dissertation is formulated as follows: to develop and evaluate an integrated framework for fake-news detection and diffusion analysis on social networks by combining Transformer-based language models, temporal-network representation, SIR/SEIZ epidemiological modelling, and Approximate Bayesian Computation for uncertainty-aware parameter inference.

To achieve this goal, a number of seven tasks have been formulated. I summarize them as follows:

Task 1: To implement and evaluate a Transformer-based binary fake-news detection layer using models such as BERT, RoBERTa, BigBird, mBERT, and XLM-RoBERTa across short-text, long-text, healthcare-related, English, and low-resource Albanian fake-news datasets.

Task 2: To construct directed temporal fake-news cascades from social-network interaction data and extract key diffusion quantities, including new active spreaders, cumulative active spreaders, cascade size, time to peak, and temporal-network structure.

Task 3: To compare SIR and SEIZ epidemiological models for fake-news diffusion modelling and determine whether exposed and skeptic/non-spreading states provide a more suitable representation of fake-news propagation than a simpler SIR baseline.

Task 4: To apply ABC and ABC-SMC methods for uncertainty-aware inference of epidemiological diffusion parameters from partially observed fake-news cascades, including posterior parameter estimation, credible intervals, posterior predictive validation, and short-horizon forecasting.

Task 5: To integrate Transformer fake-news probability, temporal-network amplification, SEIZ-based diffusion modelling, and ABC-SMC posterior predictive

growth into a Baseline Posterior Fake-News Diffusion-Risk Functional, and to use the calibrated framework for cautious counterfactual intervention scenario analysis.

I consider that the so formulated goal and tasks accurately reflect the main ideas realized in the dissertation. The relevance and significance of the results obtained are well presented in the main text.

A number of eight contributions of the dissertation are presented. I reformulate them and summarize as follows:

1. An integrated framework that connects Transformer-based fake-news detection, temporal cascade reconstruction, SIR/SEIZ epidemiological modelling and ABC/ABC-SMC posterior inference was proposed and evaluated. The fake news is treated as a content-to-cascade process rather than as an isolated text-classification problem.
2. The models BERT, RoBERTa, BigBird, mBERT and XLM-RoBERTa were implemented and evaluated across short-text, long-text, healthcare and low-resource Albanian fake-news datasets.
3. A comparison between SIR and SEIZ epidemiological models on the principal empirical fake-news cascades is done and the outperformance of SEIZ model is demonstrated. As a result, SEIZ is used as the main diffusion model.
4. The methods ABC (Approximate Bayesian Computation) and ABC-SMC are applied to estimate uncertain epidemiological parameters from partially observed social-network cascades.
5. A baseline risk functional is proposed that links Transformer fake-news probability, temporal-network amplification and ABC-SMC-SEIZ posterior predictive growth.

A number of five publications are attached to the dissertation, that reflect some of the scientific results. One of them is standalone. One publication is in an IEEE edition with impact rank, three publications are in an IEEE edition. It can be concluded that the results obtained are recognized in scientific circles. A number of four citations of the publications to the dissertation are provided.

The abstract has a volume of 57 pages in English (63 pages in Bulgarian). I consider that it accurately reflects the content of the dissertation.

Conclusion

I accept that the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for its implementation, the Regulations on the terms and conditions for obtaining scientific degrees and holding academic positions at BAS and the Regulations on specific conditions for acquisition of scientific degrees and for holding academic positions at the Institute of Information and Communication Technologies – BAS are met.

I give a positive assessment for the acquisition of the educational and scientific degree "Doctor" of Kristel Gjergj Vula.

I recommend to the esteemed Scientific Jury members to award the educational and scientific degree "Doctor" of Kristel Gjergj Vula in the scientific field: 4. Natural Sciences, Mathematics and Informatics, Professional field: 4.6 Informatics and Computer Science, doctoral program: Informatics.

September 08, 2026

Sofia

