

To the Specialized Academic Council
DF 58.082.087
at the West Ukrainian National University
of the Ministry of Education and Science
of Ukraine
Doctor of Technical Sciences, Professor,
Anatoliy Sachenko

REVIEW

*of the opponent Dmytro Dosyn
Doctor of Technical Sciences, Senior Researcher, Head of the Department of
Information Systems and Networks,
on the qualification thesis of Pan Tiande on the topic:
" Methods and Software Tools for Recognizing Fake or Irrelevant Information in the
Content of News-Oriented Social Networks ", submitted for the degree of Doctor of
Philosophy in
specialty 121 " Software Engineering "*

1. Relevance of the Dissertation Topic

Modern news-oriented social networks have become one of the key sources of information for a wide audience, fundamentally transforming the structure of information flows and the mechanisms through which they are perceived. However, alongside the expansion of digital communication capabilities, the risks associated with the dissemination of false, manipulative, or irrelevant content are increasing significantly. The large volume of user-generated posts, the absence of editorial oversight, and the dominance of emotionally charged messages create a favorable environment for the spread of misinformation, which can rapidly scale and influence public opinion, political processes, and information security.

The issue of news content credibility deserves particular attention, as social networks are characterized by high data-update rates, heterogeneous formats, and a substantial share of unverified statements. Traditional fact-checking methods and standalone software tools address only a limited subset of tasks—such as identifying suspicious claims, retrieving previously verified facts, or analyzing information diffusion. However, they do not provide a comprehensive, multi-level analysis that incorporates user behavioral patterns, temporal dynamics of reactions, the structure of interactions, and data uncertainty, all of which are intrinsic to social media environments.

In this context, the development of novel methods and software tools capable of performing integrated detection of false or irrelevant information within news-oriented content becomes highly relevant. Their creation requires the combination of interval-based data processing approaches, ontological modeling of the subject

domain, behavioral analysis methods, and the use of intelligent agents for automated data retrieval, evaluation, and validation in real time.

Addressing this scientific challenge will improve the accuracy and speed of fake-content detection, reduce the impact of misinformation, and contribute to strengthening information security in the modern digital society.

2. Analysis of the Dissertation Content. Degree of Validity of the Scientific Provisions, Conclusions, and Recommendations Formulated in the Dissertation

2.1. The dissertation is a completed research work consisting of an abstract, introduction, four chapters, conclusions, a list of references, and appendices. The logical structure of the work is determined by its overall goal and the formulated scientific and practical objectives.

The introduction substantiates the relevance of the dissertation topic and clearly formulates the research aim and key tasks. It provides a generalized description of the scientific novelty and practical significance of the obtained results. Particular attention is paid to the approbation of the research findings and publications based on the dissertation materials, with a detailed specification of the author's personal contribution to joint scientific works.

The first chapter clarifies the essence of the problem of detecting fake information in a dynamic digital environment and identifies the key factors that hinder the automatic assessment of the credibility of social media content. A classification of contemporary fake-detection methods is presented, highlighting their advantages and limitations. The capabilities of existing fact-checking software services are analyzed, emphasizing that they address only certain aspects of the problem and do not provide a comprehensive solution.

Based on this analysis, the necessity of developing a hybrid credibility assessment method that integrates interval, behavioral, and network models is substantiated. The research problem is formulated to improve fake-content detection by constructing interval-based user models and software agents for automated information verification.

The second chapter examines quantitative indicators of social media user profiles and demonstrates that audience reaction dynamics (number of posts, shares, likes, comments, speed and virality of content dissemination) can serve as indicators of potentially false information. Based on this, an interval mathematical model for credibility assessment is proposed for the first time, in which the degree of credibility is represented as an interval value within $[0, 1]$, reflecting the influence of key behavioral and content-related factors.

The dissertation proposes, for the first time, a hybrid method for identifying interval models of user profiles that integrates a metaheuristic algorithm based on the artificial bee colony behavioral model with gradient-based parameter refinement methods. This approach reduces computational complexity and enables the application of standard optimization procedures for solving model identification tasks. Verification of the proposed approach is demonstrated through the simulation of user reactions to news content in social networks.

At the same time, it is emphasized that quantitative behavioral indicators are suitable for preliminary detection of suspicious content but do not ensure complete confirmation of its falsity. Therefore, further research focuses on the integration of additional mechanisms for analyzing content, sources, and contextual relationships to improve classification accuracy.

The third chapter substantiates the use of a multi-agent approach for automated collection and analysis of news-oriented social media content. Using the proposed method, an integral credibility index is developed, taking into account source reliability, statement consistency, network confirmation, emotional tone, and temporal relevance. The architecture of software agents is implemented and integrated with interval user modeling, which improves the accuracy of credibility assessment. Experimental studies on real-world data demonstrate a classification accuracy exceeding 90% and confirm the effectiveness of the system in detecting fake content.

The fourth chapter presents a comprehensive software environment for detecting and analyzing fake content, combining natural language processing methods, analytical credibility assessment, interval-based user behavior modeling, and visual analytics tools. A modular software architecture has been developed, including subsystems for data acquisition, analytical processing, interval modeling, a knowledge base, and an interactive web interface. A data management subsystem based on MongoDB and an interactive interface for content analysis and monitoring of credibility indicators are implemented. System effectiveness is confirmed by an integral index of 0.92, which significantly exceeds known analogues and demonstrates high accuracy, adaptability, and practical applicability of the developed solution.

The conclusions summarize the obtained results and fully meet the requirements applied to dissertation research.

The appendices are substantive and support the main results, containing documentation and certificates confirming the implementation and use of the outcomes of the dissertation research.

Overall, the structure of the dissertation fully corresponds to the logic and sequence of solving the stated research tasks.

2.2. The main scientific results of the dissertation are sufficiently substantiated. The scientific provisions, conclusions, and recommendations presented in the dissertation are based on a comprehensive analysis of the obtained results and the application of scientific approaches from modern theory and practice concerning interval data analysis, methods for assessing content credibility, and their software implementation. The reliability of the scientific statements, conclusions, and recommendations is confirmed by the results of experimental studies as well as by the practical implementation of the developed solutions. Based on the analysis of the main part of the dissertation, it can be concluded that the aim of the research has been fully achieved and that the dissertation constitutes a completed scientific qualification work.

3. Scientific Novelty of the Dissertation

The principal scientific provisions, results, and conclusions of the dissertation were obtained independently by the author. They are original, sufficiently substantiated, and confirmed by computer-based experiments as well as by the approbation of the main findings at national and international scientific conferences.

The scientific novelty obtained by the author includes the following:

For the first time:

- an interval mathematical model has been developed that establishes a relationship between the credibility of content in news-oriented social networks and users' behavioral profiles. In contrast to existing approaches, the model is based on the analysis of interval data under limited sample conditions, which enhances the efficiency of early detection of unreliable information;

- a hybrid method for identifying interval models of user profiles in social networks has been proposed and substantiated. Unlike known approaches, it combines a metaheuristic algorithm for model-structure synthesis based on the behavioral model of an artificial bee colony with gradient-based methods for parameter identification of candidate models. This integration has reduced the computational complexity of the identification process and improved the early-stage recognition of content credibility.

Further developed:

- software agents for assessing the credibility of content in news-oriented social networks, which, unlike existing solutions, integrate both traditional criteria—redundancy, inconsistency, timeliness, reliability, and completeness—and new characteristics of the digital environment, including network confirmation and emotional tone. This significantly increases the effectiveness of fake-content detection;

- software environments for detecting and analyzing fake content in news-oriented social networks, which, unlike known systems, combine automated tools for retrieving data from social platforms with credibility-assessment modules capable of functioning under limited data conditions, and are adapted to operate as intelligent assistants supporting the creation and deployment of news services.

4. Compliance with Academic Integrity Requirements and Completeness of the Presentation of Scientific Results in Published Works

4.1. The dissertation comprises 156 pages of printed text, including 126 pages of the main content, which contains 38 figures and 4 tables. The list of references includes 126 sources, and the work contains 3 appendices.

The dissertation is written in English and demonstrates a high stylistic quality. The scientific terminology used is generally accepted, and the style of presenting the results of theoretical and applied research, novel scientific provisions, conclusions, and recommendations ensures their clarity and accessibility for perception and practical use. The content of the dissertation provides a clear understanding of the author's main statements, conclusions, and recommendations. The style of presentation guarantees an adequate comprehension of the research materials and

scientific findings. The formatting of the dissertation fully complies with the required attestation standards.

4.2. Compliance with Academic Integrity Requirements. The dissertation has undergone an academic plagiarism check, and the results confirm its high degree of originality. The author's individual style is distinctly observed throughout the text. No textual borrowings or usage of results from other researchers without proper referencing were identified.

4.3. Completeness of the Presentation of Scientific Results in Publications. The main research results have been published in 8 scientific works, including 6 articles in scientific periodicals and 2 publications in the proceedings of international scientific and technical conferences. Five of these works are indexed in international scientometric databases such as Scopus and Web of Science.

5. Practical Significance of the Dissertation Results

The practical significance of the dissertation lies in the development of methods and software tools for automated detection and analysis of unreliable content in news-oriented social networks. The proposed interval models, hybrid evaluation methods, and multi-agent software environment can be applied in fact-checking systems, information-space monitoring platforms, digital analytics, and content-moderation services.

The developed solutions improve the accuracy, timeliness, and explainability of credibility assessment processes and can be integrated into web-oriented analytical platforms and news services.

6. Comments on the Dissertation

Considering the high quality of the conducted research, it is nevertheless necessary to draw attention to several discussion points, suggestions, and comments regarding the dissertation:

1. In the first chapter, it would be advisable to expand the literature review by including a comparative analysis of modern metaheuristic search-optimization algorithms.

2. The construction of interval models is well justified; however, the author should provide a more detailed explanation of how interval width affects the stability and sensitivity of the resulting model, as this directly influences the accuracy of content credibility assessment.

3. While the author substantiates the use of limited data samples, the dissertation should more clearly delineate the applicability boundaries of the developed models and describe their behavior in cases of high variability or changes in user-group characteristics.

4. The visual analytics subsystem is presented at a high level; however, it would be useful to compare the system's interactive interface with existing industrial solutions, particularly regarding usability, informativeness, and adaptability to various application scenarios.

5. Although the author claims advantages of the developed environment over existing tools, the comparative analysis is based on a limited set of indicators and does

not employ standardized metrics, which somewhat weakens the strength of the argumentation.

However, the above comments do not have a fundamental impact and do not diminish the overall scientific value of the dissertation.

7. Conclusions

The presented dissertation “Methods and Software Tools for Recognizing Fake or Irrelevant Information in the Content of News-Oriented Social Networks ” is well justified in terms of its relevance and contains completed scientific research whose results demonstrate scientific novelty and practical significance. The dissertation successfully addresses the important scientific task of improving the efficiency of detecting and analyzing fake content in news-oriented social networks under conditions of limited data samples through the development of appropriate mathematical models and software agents. The obtained results play an important role in the advancement of the field of knowledge 12 Information Technologies and the specialty 121 Software Engineering.

Therefore, considering the relevance of the dissertation topic, the established scientific novelty and practical value of the obtained results, the completeness of their presentation in scientific publications, and the absence of violations of academic integrity, I conclude that the dissertation meets the requirements of the Order of the Ministry of Education and Science of Ukraine No. 40 of January 12, 2017 “On the Approval of Requirements for Dissertation Formatting”, as well as the Procedure for Awarding the Doctor of Philosophy Degree and Revoking Decisions of Ad Hoc Specialized Academic Councils of Higher Education Institutions and Research Institutions on Awarding the Doctor of Philosophy Degree (Resolution of the Cabinet of Ministers of Ukraine No. 44 of January 12, 2022).

The author, Pan Tiande, deserves to be awarded the degree of Doctor of Philosophy in the field of knowledge 12 Information Technologies, specialty 121 Software Engineering.

Official Opponent:

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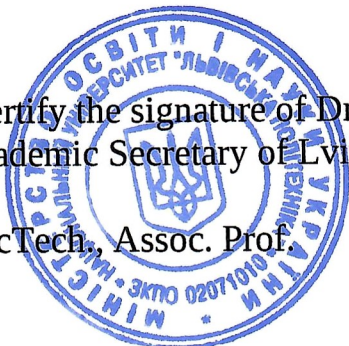


Dmytro DOSYN

I certify the signature of Dmytro Dosyn:

Academic Secretary of Lviv Polytechnic National University

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Roman BRYLYNSKYI