UDC 621.3.049.77–048.24:537.2

ARTIFICIAL INTELLIGENCE FOR MUSIC GENERATION

Likhachou A.A.

Belarusian State University of Informatics and Radioelectronics, Minsk, Republic of Belarus

Klokova A.G. – Cand. of Sci. (Philology), Associate professor, Head at the Department of Foreign Languages

Annotation. Artificial intelligence is becoming an essential tool in music generation, utilizing various algorithms such as recurrent neural networks, transformers, generative adversarial networks, and variational autoencoders. These methods enable AI to compose, assist musicians, and create background music for films, video games, and advertisements. While AI can generate structured and stylistically coherent music, it lacks the emotional depth and cultural awareness of human composers. Rather than replacing musicians, AI serves as a creative assistant, expanding artistic possibilities and transforming the way music is produced. This paper explores the key algorithms behind AI-generated music and their impact on the industry.

Key words: artificial intelligence (AI), machine learning (ML), artificial neural network (ANN), algorithms.

Introduction. Artificial intelligence (AI) is transforming nearly every aspect of modern life, from healthcare and finance to education and entertainment. Its ability to process vast amounts of data, recognize patterns, and make decisions has made it an essential tool across industries. In creative fields, AI is opening new possibilities, pushing the boundaries of human imagination. One of the most intriguing areas is AI-generated music, where algorithms can compose, remix, and even perform music with minimal human intervention.

Music generation with AI is not just a technological experiment; it is a rapidly evolving field that challenges traditional notions of creativity. Companies and independent researchers are developing models that analyze musical structures, learn from vast datasets, and create compositions that mimic or innovate upon human-made music. From aiding musicians in songwriting to generating background scores for films and video games, AI is becoming an indispensable creative partner. This article explores the key algorithms used in AI-driven music generation, examining how they work and their impact on the music industry.

Main part. Understanding the core concepts behind AI-driven music generation requires a clear definition of fundamental terms.

Artificial Intelligence refers to the field of computer science focused on creating systems capable of performing tasks that typically require human intelligence [1]. These tasks include problem-solving, pattern recognition, decision-making, and learning from data. AI encompasses various subfields, including machine learning and deep learning, which enable automated processes without explicit programming for each task.

Machine Learning (ML) is a subset of AI that enables systems to learn patterns from data and make predictions or decisions based on those patterns [1]. ML models improve their performance over time by analyzing new data, making them particularly effective for tasks such as classification, recommendation, and generative processes, including music composition.

Deep Learning (DL) is a specialized branch of ML that utilizes artificial neural networks with multiple layers to model complex patterns in data [1]. Deep learning algorithms excel at processing unstructured data, such as audio, images, and natural language, making them crucial for AI-based music generation. These models can analyze vast amounts of musical compositions and generate original pieces based on learned structures.

Artificial Neural Networks (ANNs) are computational models inspired by the human brain, consisting of interconnected layers of artificial neurons [1]. ANNs process input data through weighted connections, allowing the network to recognize patterns and generate outputs based on learned relationships. In the context of music generation, ANNs are used to analyze and synthesize musical elements, enabling AI to create compositions that resemble human-made music.

Now, let us examine the algorithms themselves. In the article, it is shown that AI-based music generation relies on various approaches, including neural networks, probabilistic models, and algorithmic composition [2]. Deep recurrent networks, such as Long Short-Term Memory (LSTM), learn from sequences of notes and generate coherent melodies by capturing long-term dependencies. Generative Adversarial Networks (GANs) are used to create more expressive musical pieces, where one network generates melodies while another evaluates their quality, refining the output to resemble human compositions.

Beyond neural networks, probabilistic models, such as Hidden Markov Models (HMMs), predict the most likely note sequences based on statistical dependencies. In his article, the author highlights that these models perform well in traditional composition frameworks but are less effective in generating complex musical structures compared to neural networks [2].

Now, let's examine the algorithms presented in the study, conducted by Lopez-Rincon O., Starostenko O., Ayala-San Martin G. This study explores various AI methods used in music generation, including symbolic and audio-based approaches. Symbolic methods operate on structured representations such as MIDI files, allowing for precise control over musical elements. These approaches frequently employ recurrent neural networks (RNNs), including LSTM models, which learn temporal dependencies and generate melodies with coherent harmonic progressions. The study also highlights the role of transformer models, which, due to their attention mechanisms, effectively capture long-range dependencies and produce complex musical structures [3].

In contrast, audio-based methods work directly with raw sound waves or spectrograms, utilizing convolutional neural networks (CNNs) and autoencoders. These models analyze and generate high-fidelity audio representations, enabling AI to synthesize realistic instrument sounds and even human-like singing. It was also mentioned that GANs are applied to audio-based music generation. Additionally, evolutionary algorithms can act as an alternative approach to AI-driven composition. These models generate music through iterative selection and mutation processes, optimizing musical features based on predefined aesthetic or structural criteria [3].

This study provides a broad overview of AI-based music generation systems, discussing both previously mentioned models and additional approaches. As covered earlier, methods such RNNs, LSTM networks, transformers, and GANs play a significant role in symbolic and audio-based music generation [4].

The study also discusses rule-based systems, where music is generated using predefined compositional rules and heuristics. Unlike machine learning approaches, these systems do not rely on large datasets but instead encode expert knowledge, ensuring stylistic coherence while limiting generative flexibility. Furthermore, the authors highlight the use of variational autoencoders (VAEs) in music generation. These models encode musical data into a compressed latent space and decode it to generate new compositions, enabling structured and diverse musical outputs while maintaining stylistic consistency [4].

Conclusion. AI music generation employs diverse algorithms, from statistical models to deep learning like RNNs, transformers, GANs, and VAEs, alongside rule-based and evolutionary systems. Consequently, AI is prevalent in music production, aiding composers and democratizing creation, evident in various media; however, while AI enhances creativity by generating structured pieces, it lacks the emotional depth and cultural insight of human composers, ultimately serving as a powerful tool to augment human artistry.

References

1. *Maxfield C. Fundamentals of AI: ANNs, ML, DL, and DNNs [Electronic resource]. Mode of access: https://www.clivemaxfield.com/coolbeans/fundamentals-ai-anns-ml-dl-and-dnns/. Date of access: 25.03.2025.*

2. *Techies Camp. What is ML, ANN, and DL? [Electronic resource]. Mode of access: https://blog.techiescamp.com/docs/what-is-ml-ann-and-dl/. Date of access: 25.03.2025.*

3. *Lopez-Rincon O., Starostenko O., Ayala-San Martin G. (2018) Algorithmic Music Composition Based on Artificial Intelligence: A Survey. In: 2018 International Conference. IEEE, pp. 187–194.*

4. *Kaliakatsos-Papakostas M., Floros A., Vrahatis M.N. (2020) Artificial Intelligence Methods for Music Generation: A Review and Future Perspectives. In: Nature-Inspired Computation and Swarm Intelligence. Elsevier, pp. 217–244.*

5. *Carnovalini, F., and Rodà, A. (2020). Computational Creativity and Music Generation Systems: An Introduction to the State of the Art. Front. Artif. Intell. 3:14.*