ICRAMCS 2026
THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 23-24-25, 2026 | Marrakech, Morocco

Evolutionary Algorithm-Based Construction and Decoding for Enhanced Error-Correcting Codes

Communication Info

Authors:
El Mehdi BELLFKIH[1]
Imrane CHEMSEDDINE IDRISSI[2]
El Mahdi LAMAIZI[3]
[1] Faculty of sciences, Casablanca, Morocco
[2] Faculty of sciences, Casablanca, Morocco
[3] Faculty of Sciences, Kenitra, Morocco

Keywords:
(1) Genetic algorithm
(2) ECCs
(3) Construct
(4) Decoding
(5) Complexity

Abstract

This paper presents a genetic algorithm (GA) approach for constructing and decoding error-correcting codes (ECCs). Classical ECCs rely on time-consuming matrix operations, creating inefficiencies when correcting multiple errors. Recent work has demonstrated GAs effectiveness in coding theory, including computing automorphism groups of LDPC codes [1] and discovering involutory MDS matrices [2]. Building on these foundations and prior GA-based decoding using permutations [4,5], our method optimizes generator vectors to maximize minimum distance between codewords, enhancing error correction while reducing encoding complexity from O(kn) to O(k(n−k)).

We demonstrate this framework [3] with a code of length 31, dimension 12, and minimum distance 7. For decoding, the GA efficiently corrects errors in received sequences through adaptive search. At 7.7 dB signal-to-noise ratio, the system achieves a 10^{-5} bit error rate after only nine GA generations, demonstrating rapid convergence and robust performance.

This work shows that evolutionary algorithms can simplify encoding while maintaining strong error correction, offering practical benefits for communication systems.

References

[1] Bellfkih, E.M., Nouh, S., Idrissi, I.C., Ettaoufik, A., Louartiti, K., & Mouline, J. (2022). On the computation of the automorphisms group of low density parity check codes using genetic algorithm. *Indonesian Journal of Electrical Engineering and Computer Science*.

[2] Bellfkih, E.M., Nouh, S., Idrissi, I.C., Louartiti, K., & Mouline, J. (2023). Genetic Algorithm-Based Method for Discovering Involutory MDS Matrices. *Comput. Math. Methods.*

[3] Bellfkih, E.M., Nouh, S., Chemseddine Idrissi, I., Louartiti, K., & Mouline, J. (2025). New family of error-correcting codes based on genetic algorithms. *IAES International Journal of Artificial Intelligence (IJ-AI)*.

[4] Nouh, S., Chana, I., & Belkasmi, M. (2013). Decoding of Block Codes by using Genetic Algorithms and Permutations Set. *Int. J. Commun. Networks Inf. Secur., 5*.

[5] Faham, H., Kasmi Alaoui, S.E., El Assad, M., Nouh, S., Chana, I., & Azzouazi, M. (2022). A New Fast Iterative Decoder of Product Codes Based on Hash and Syndromes and Optimized by Genetic Algorithms. *International Journal of Engineering Trends and Technology*.