IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

AI-Assisted Mathematics And Recent Breakthroughs (2025)

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Abstract -

This research paper discusses two highly innovative and relevant areas of modern mathematics:

(1) The role of Artificial Intelligence in mathematical research

(2) The progress made in the 3-Dimensional Kakeya Conjecture in 2025

This study demonstrates how AI-based technologies are revolutionizing mathematical theories, proofs, and the solutions to complex problems.

Keywords: AI, Mathematical Research, Progress, New Possibilities!

1. Introduction :-

Mathematical research has always been associated with the exploration of complex problems and abstract structures. In recent years, Artificial Intelligence (AI) has given a new direction to the traditional form of mathematics. Simultaneously, progress in long-standing unsolved problems like the Kakeya Conjecture has opened up new possibilities in the fields of geometric measure theory and harmonic analysis.

2. Background and Motivation :-

2.1 Artificial Intelligence in Mathematics :-

The use of AI is no longer limited to computational problems; it is also proving helpful in higher-level mathematical tasks such as theorem proving, symbolic reasoning, and conjecture formation. The integration of AI with formal proof systems like Lean and Coq is accelerating the pace of mathematical research.

2.2 Need for AI-Based Mathematical Research :-

Human-centered mathematical research has limitations in terms of time and resources. AI mitigates these limitations, making it possible to analyze more complex and extensive mathematical structures.

3. Kakeya Conjecture: A Recent Breakthrough :-

3.1 Overview of the Kakeya Problem :-

The Kakeya Conjecture is a famous problem in geometric measure theory, which studies the smallest possible set in which a unit line segment can be rotated in every direction.

3.2 Significance of the 3D Kakeya Result (2025) :-

The recent progress in the 3-Dimensional Kakeya Conjecture has had a significant impact on the fields of fractal geometry, partial differential equations, and Fourier analysis. This result demonstrates a deep connection between measure and dimension in high-dimensional spaces.

4. Role of AI in Mathematical Discovery :-

4.1 AI as a Research Assistant :-

AI systems are now playing the role of a co-researcher for mathematicians. They not only verify existing proofs but are also becoming capable of suggesting new conjectures.

4.2 Limitations and Ethical Concerns :-

Although AI is powerful, mathematical correctness, explain ability, and human validation remain essential. Human review is necessary before fully accepting AI-generated proofs.

5. Discussion :-

AI-based mathematical research is also benefiting fields such as education, cryptography, data science, and computational physics. This interdisciplinary approach is making mathematics more practical and application-oriented.

6. Conclusion :-

This research paper concludes that the future of modern mathematics will be based on the collaboration of human intelligence and artificial intelligence. Progress on difficult problems like the Kakeya Conjecture proves that new technologies can take mathematical research to new heights.

References:-

1. Research articles on AI-assisted theorem proving

2. Studies on geometric measure theory and Kakeya sets

3. Recent developments in computational mathematics

4. Survey papers on AI in modern mathematical research