

1 Statistical Analytical Review of Deep Learning Paradigms for 2 Cancer Classification and Prognostic Modeling 3

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8 Deep learning has transformed cancer diagnosis, but statistical understanding of model behavior, repeatability,
9 and generalizability remains limited. This study presents a statistical examination of 100 deep learning
10 frameworks for cancer classification, prognostic modeling, and radiomic feature extraction across malignancies.
11 Iterative comparison study measures CNN, transformer topology, multimodal fusion model, and metaheuristic
12 optimization framework accuracy, precision, recall, F1-score, and AUC metrics. Ensemble and hybrid models
13 incorporating radiomics or genomic correlations outperform single-stream CNNs with mean accuracies above
14 96% and AUCs above 0.98.
15

16 Additional Key Words and Phrases: Deep Learning, Cancer Classification, Radiomics, Statistical Analysis,
17 Explainable AI
18

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23 **1 Introduction**

24 Digital clinical data and high-resolution medical imaging have altered cancer diagnosis. Automated,
25 data-driven diagnostic methods are in high demand as healthcare companies pursue precision
26 oncology. Traditional statistical models cannot find complex patterns in histology slides, radiological
27 scans, and genetic data, but deep learning's hierarchical feature extraction and adaptive learning can
for different scenarios. Deep learning cancer detection research is growing rapidly, but interpretive
and statistical consistency is lacking.

28 **2 Literature Review**

29 **2.1 Brain Cancer Analysis**

30 Deep learning in cancer categorization has improved computational medicine and diagnostics. Many
31 brain cancer detection investigations use iterative analytical methods to maximize convolutional
32 structures, transfer learning, and statistical generalizability.
33

34 **2.2 Statistical Analysis**

35 Quantitative evaluation is needed to assess deep learning architecture cancer classification reliability.
36 The linked works provide empirical or statistically simulated cancer domain comparison accuracy,
37 precision, recall, F1-score, AUC, and sensitivity.
38

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50 Table 1. Representative Brain Cancer Analysis Techniques
51

52 Reference	Method	Strengths	Limitations
53	CNN with Transfer Learning	Robust transfer adaptability	Limited dataset diversity
54	Hybrid CNN Architecture	Versatile architecture	High computational load
55	Fine-tuned Deep Models	Effective fine-tuning strategy	Sensitive to hyperparameter tuning

56 Table 2. Performance Metrics Summary
57

60 Cancer Type	Best Method	Accuracy	Precision	Recall	AUC
62 Brain	Deep Residual Learning	98.1%	97.5%	97.9%	0.990
63 Liver	HCCNet Fusion	98.3%	97.8%	97.9%	0.993
64 Breast	Ensemble Deep Learning	97.2%	96.5%	96.6%	0.988
65 Skin	Attention-based Multi-class DL	97.5%	96.9%	97.1%	0.989
66 Lung	CNN + Transformer	97.8%	97.2%	97.4%	0.992

67

3 Conclusion

68 Due to exponential medical imaging data expansion and precision oncology, automated, scalable, and
 69 statistically verified cancer categorization systems are needed. Current research was scattered, and
 70 single contributions, if methodologically sound, lacked iterative validation, statistical harmonization,
 71 and interpretability across data sources. This review presents a robust quantitative and theoretical
 72 underpinning for deep learning-driven cancer classification systems.

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