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Particle Point Cloud vs. Static Images from WBC Scattergrams: Performance in AI-Driven APL Screening

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INTRODUCTION

White blood cell differential scattergrams from hematology analyzers capture morphological features that can be used for disease screening. Recent studies have demonstrated the feasibility of AI-based acute promyelocytic leukemia (APL) screening using static images of scattergrams (side scatter light, SSC versus side scatter fluorescence, SFL axes). However, the generalizability across different analyzer platforms remains unclear. Moreover, scattergrams originate from point cloud data, and compression into static images may lose subtle spatial features among cell subpopulations, potentially affecting model performance – a gap not being investigated previously. This study compares APL screening models built on WBC scattergram point cloud versus static image data to propose a new screening paradigm.

METHODS

This multicenter retrospective study enrolled 646 patients from three hospitals (October 2024 to October 2025), including 68 APL, 266 non-APL AML, 186 other leukemias, and 126 lymphoma cases. Using the **Dymind DH-800** serial hematology analyzer, both particle point cloud and corresponding static images were collected. Independent convolutional neural network (CNN) models were constructed for each dataset using identical architecture (ResNet-50) and training strategy (five-fold cross-validation, Adam optimizer). Performance was evaluated by AUC, sensitivity, and specificity on an independent validation set, quantitatively assessing advantages of particle point cloud over static images.

Dymind DH-800

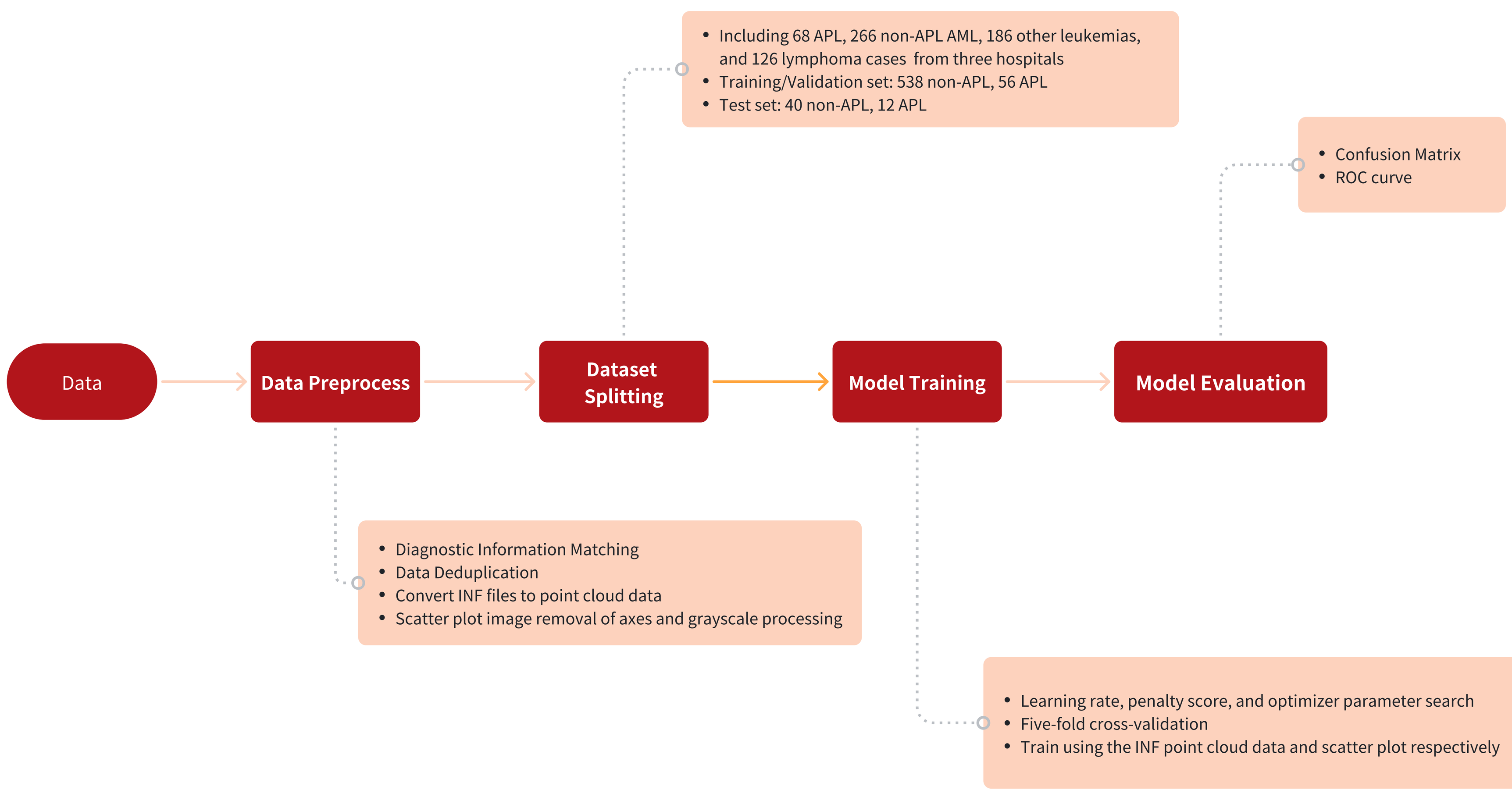
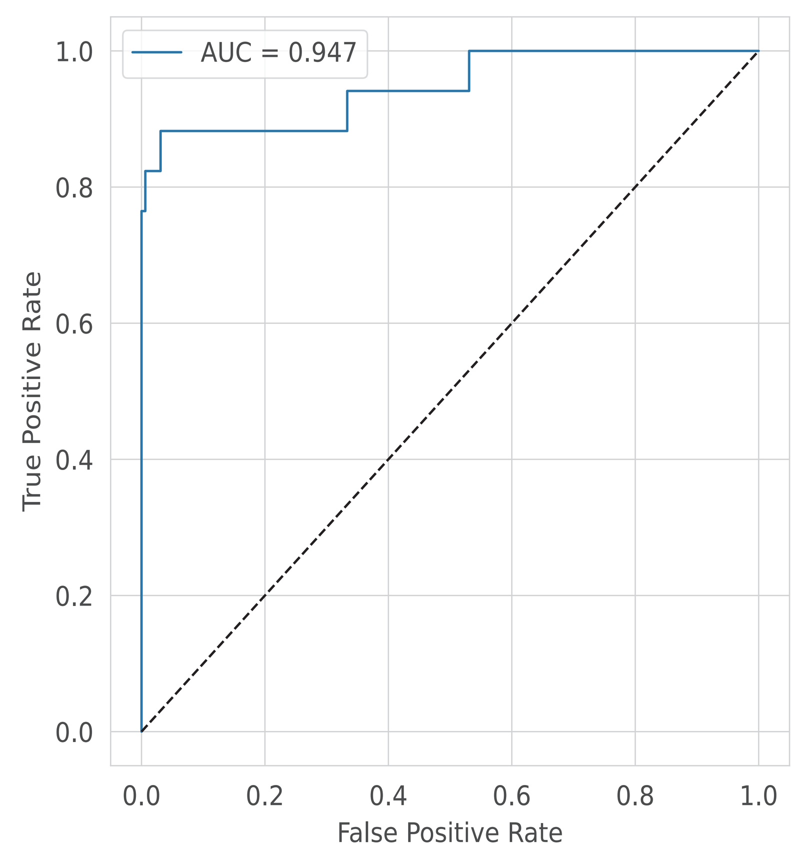


Figure 1. Flowchart of the model building.

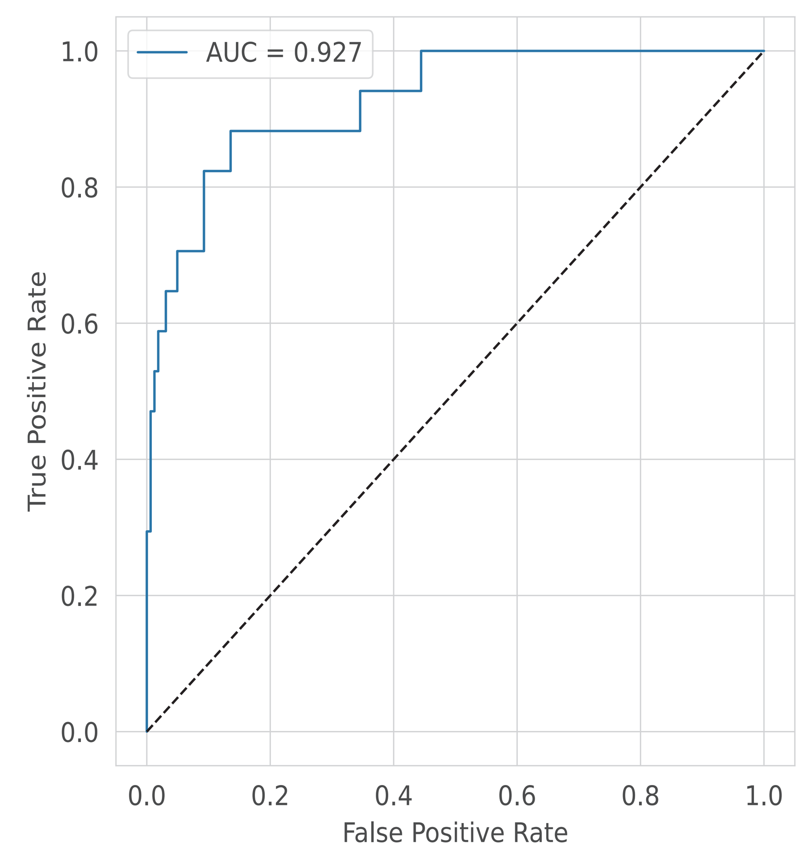
RESULTS

This study systematically compared AI models constructed based on WBC scattergrams particle point cloud data versus compressed static image data, evaluating their performance differences in APL screening. In an independent validation set (12 APL patients, 40 non-APL patients), both models demonstrated excellent screening efficacy: the point cloud model achieved an area under the receiver operating characteristic curve (AUC) of 0.947, while the static image model achieved an AUC of 0.927, with both models attaining a sensitivity of 82.4%. However, the point cloud model exhibited significant advantages in specificity, reaching 96.9%, which was markedly higher than the static image model's specificity of 86.4%.

(A)



(B)



(C)

Model	Sensitivity	Specificity	AUC
Point Cloud Model	82.4%	96.9%	0.947
Static Image Model	82.4%	86.4%	0.927
Difference	0%	+10.5%	+0.020

Figure 2. (A) ROC curve of the point cloud model. (B) ROC curve of the static image model. (C) Comparison of the two models.

CONCLUSION

This first comparative analysis of WBC scattergram point cloud versus static image data in AI-driven APL screening confirms that raw coordinates better preserve spatial information, enhancing APL screening efficacy. This paradigm provides an optimal technical pathway for APL early screening and can be extended to other hematological diseases, promoting a shift from traditional morphological observation to data-driven clinical decision making.