Supplementary

To enhance the rigor and reproducibility of this research, we have provided a complete hyperparameter configuration table and visualized training results in the supplementary materials. The configuration table details the final optimized hyperparameter sets for all models, while the training curves clearly illustrate the loss and accuracy trends throughout the iterative process, facilitating a comprehensive understanding of model convergence and stability. Together with the methodological descriptions in the main text, this information ensures that the experimental procedures of this study are fully reproducible.

Part I: Table

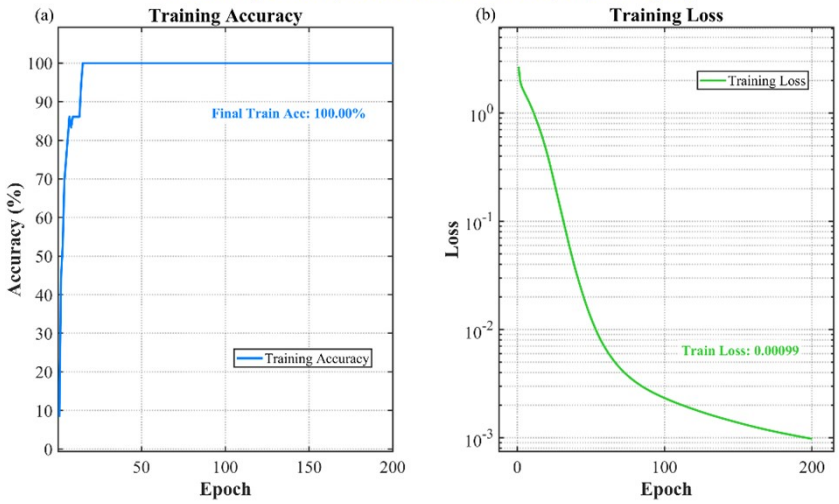
Parameter Search Ranges and Optimal Combinations for All Models Using Three-Fold Cross-Validation with Grid Search or Bayesian Optimization.

Model	**Parameter configuration**			
RF	NumTrees [50, 100, 150, 200, 250]		MaxDepth [3, 5, 7, 9]	
	100		7	
FNN-LASSO/PCA	Hidden Layer 1 Size [10, 100]	Hidden Layer 2 Size [5, 80]	Max Failures [5, 30]	
	29/18	70/25	13/21	
CNN-LASSO/PCA	KernelSize [1, min(kFeat, 5)]	NumFilters1 [8, 64]	NumFilters2 [16, 128]	InitialLearnRate [1e-4, 1e-1]
	5/5	34/37	54/106	0.016229/0.033775
LSTM-LASSO/PCA	NumHidden [32, 256]	FCUnits [16, 128]	Dropout [0, 0.5]	InitialLearnRate [1e-4, 1e-2]
	158/66	75/85	0.41/0.42	0.009931/0.003446

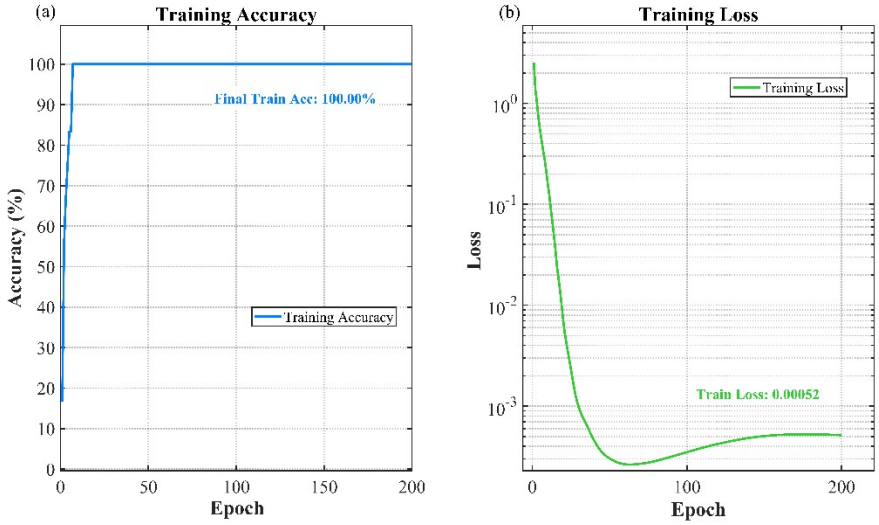
Part II: Figures

The loss and accuracy trends throughout the iterative process for all the classification models.

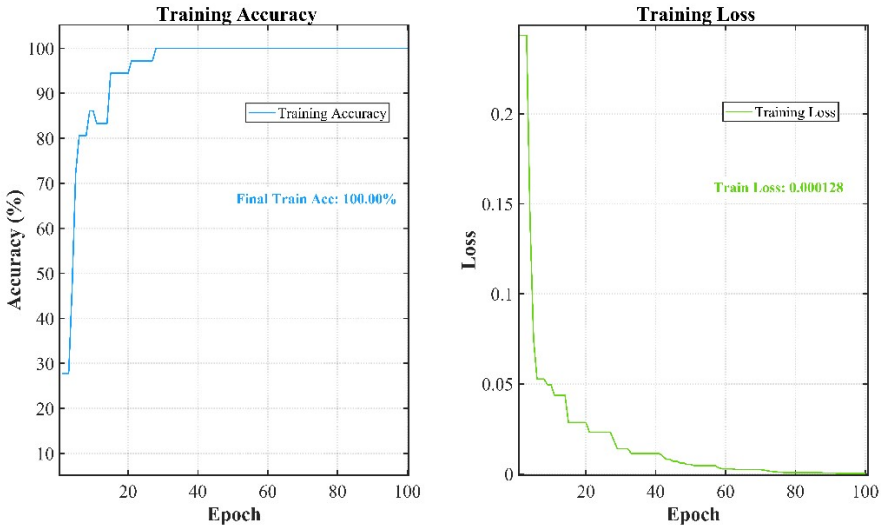
(1) LASSO-CNN model:



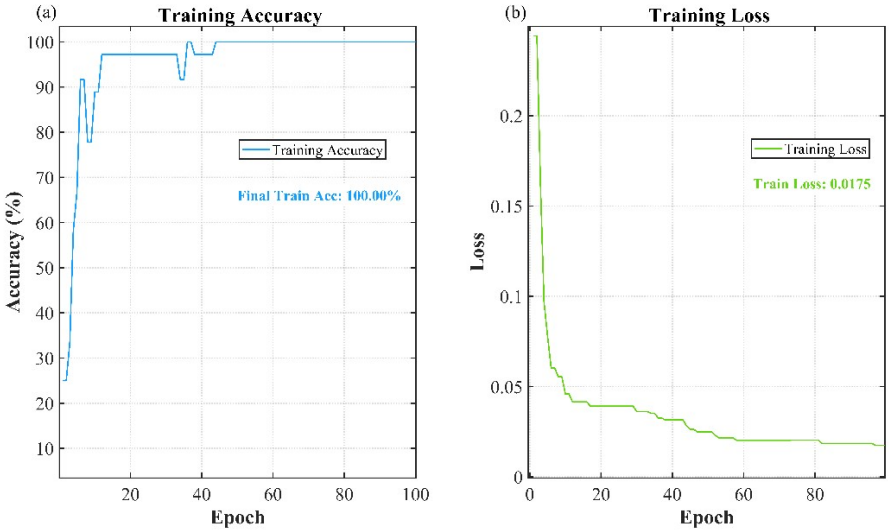
(2) PCA-CNN model:



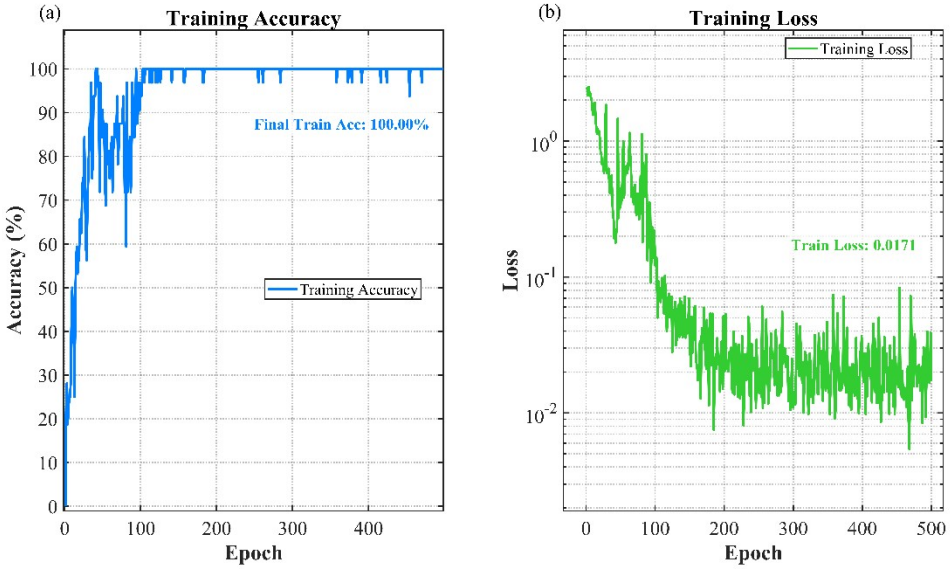
(3) LASSO-FNN model:



(4) PCA-FNN model:



(5) LASSO-LSTM model:



(6) PCA-LSTM model: