Prediction of Mycotoxin Levels in Corn using CNN on Hyperspectral Imaging Data

Abinesh

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Abstract

This report presents an approach to predicting mycotoxin (vomitoxin) levels in corn using hyperspectral imaging and deep learning. A Convolutional Neural Network (CNN) was designed and optimized for processing hyperspectral data. We detail data preprocessing, dimensionality reduction using PCA, and model evaluation, achieving an R^2 score of 0.9442.

1 Introduction

Mycotoxins, particularly deoxynivalenol (DON), pose health risks in food products. Hyperspectral imaging provides a non-destructive method for detecting contamination. This project leverages deep learning to develop a predictive model based on hyperspectral reflectance data.

2 Methodology

2.1 Dataset and Preprocessing

- **Features:** Spectral reflectance values across 448 bands.

- **Target Variable:** DON concentration (continuous value).

- Standardized data using `StandardScaler`.

- Principal Component Analysis (PCA) reduced dimensions to 30 components.

- 80-20 train-test split applied.

2.2 Model Development

The model architecture comprises:

- **Conv1D Layers:** 128, 64, and 32 filters.

- **Kernel Sizes:** 9, 5, and 3.

- **Regularization:** Batch Normalization and Dropout.

- **Optimizer:** Adam with learning rate 0.0003.

- Trained for 200 epochs, batch size of 8.

3 Results and Discussion

The final model achieved:
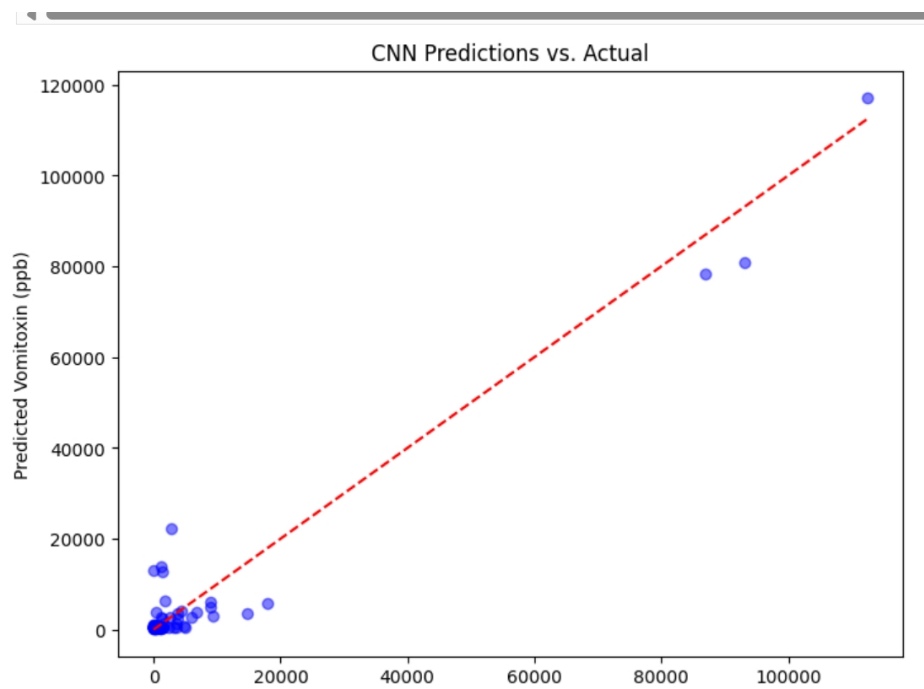
- **RMSE:** 3948.47

- **R^2 Score:** 0.9442

Figure 1: Predicted vs. Actual DON Concentration

Future improvements include hybrid models (CNN+LSTM) and attention mechanisms for enhanced feature extraction.

4 Conclusion

This project successfully demonstrates the application of CNNs for predicting mycotoxin levels in corn using hyperspectral imaging. Further research could explore alternative architectures and domain adaptation techniques.

5 References

- Hyperspectral Imaging in Food Analysis - *Journal of Food Quality*

- Deep Learning for Spectral Data Processing - *IEEE Transactions on AI*