Optimizing Influenza Trend Classification: An Image-Based Approach Using Extended Gramian Angular Fields and Distance Plots for Multivariate Datasets with Bayesian Optimization

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This study proposes a novel image-based approach for optimizing influenza trend classification using clinical lab data from Texas, California, and New York, obtained from the Centers for Disease Control and Prevention (CDC). Traditional methods like Distance Plot, Gramian Angular Summation Fields (GASF), and Gramian Angular Difference Fields (GADF) are typically designed for univariate datasets. In our approach, we extended these methods to handle multivariate datasets and used the resulting grayscale images as inputs to a Convolutional Neural Network (CNN). Bayesian optimization was employed to determine the optimal image dimensions, further enhancing the classification process. To address the ordinal nature of the severity labels (low, moderate, high, very high), we adapted the CNN with a single scalar output, using Mean Squared Error (MSE) loss, rounding, and clipping predictions to ensure consistent ordinal label outputs.

Our comparative analysis showed that the GASF method consistently achieved the lowest error rates across all three datasets, outperforming other approaches. This image-based transformation, combined with CNN architecture and Bayesian optimization, offers a promising framework for improving trend prediction in flu datasets, with significant potential for enhancing public health monitoring and intervention efforts.

Keywords: Influenza trend classification, Maximum Across Channels, Distance Plot, Gramian Angular Summation Fields, Gramian Angular Difference Fields, Bayesian optimization, Convolutional neural network, Grayscale image transformation, Flu datasets, Public health monitoring.