Integrating Spatial-Temporal Dynamics and Graph Embedding in PDE-Based Models for Predicting COVID-19 Spread

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The accurate prediction of infectious disease spread requires a comprehensive understanding of both spatial and temporal dimensions. This is crucial for improving public health outcomes. To this end, we employed graph embedding techniques to transform high-dimensional graphs into lower-dimensional vector spaces, thereby preserving their structural information. This enables us to apply partial differential equations (PDEs) more effectively for disease modeling. In this study, we developed a PDE-based model, rooted in a linear diffusive equation, to capture the spatial-temporal dynamics of COVID-19 and offer short-term predictions. Using a real dataset from Arizona, we analyzed both temporal and spatial attributes of the virus's spread and validated our model's predictive accuracy for subsequent-day case numbers. Our results indicate that the model adeptly captures the spatial-temporal features of COVID-19 and is effective in short-term case prediction.
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