A Chaotic Dynamics Framework Inspired by Dorsal Stream for Event Signal Processing

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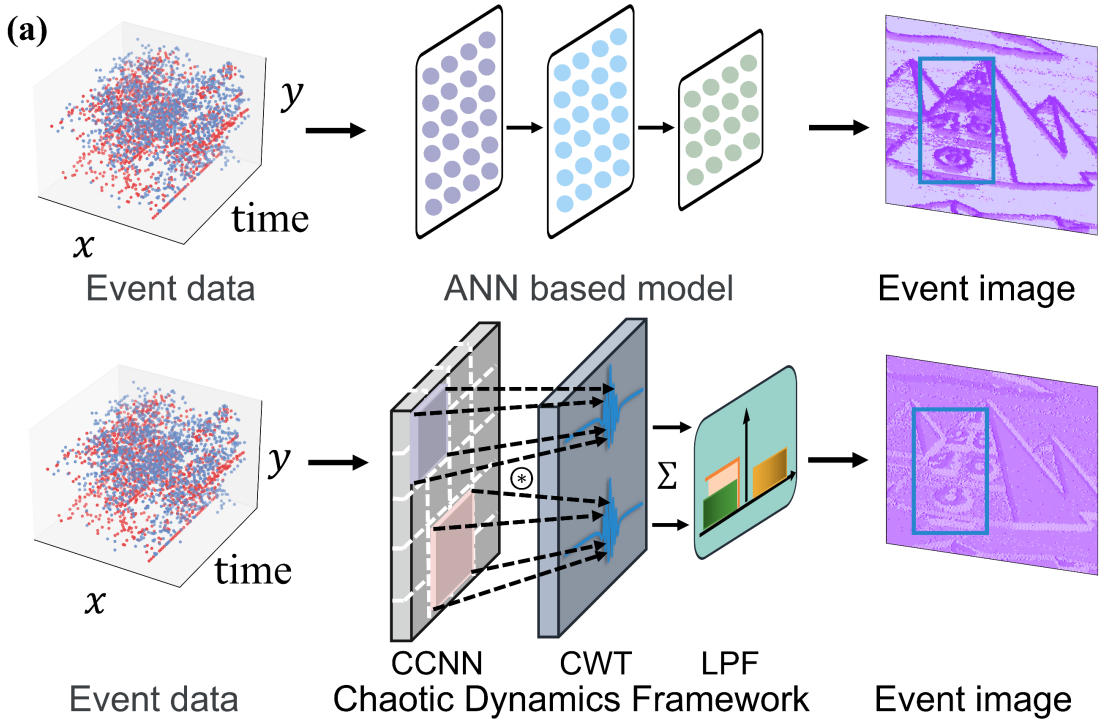
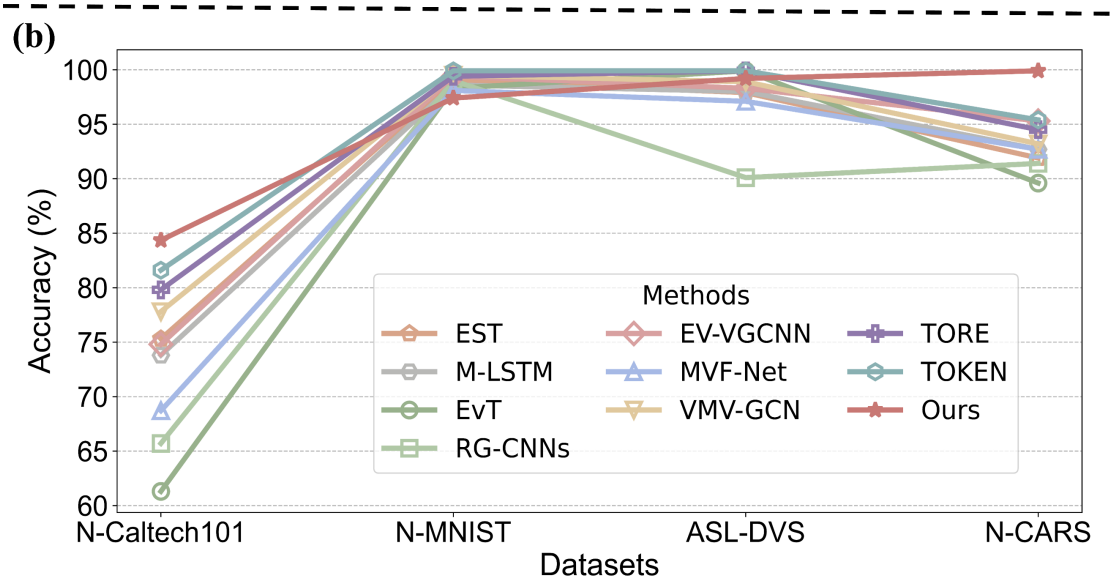




Highlights

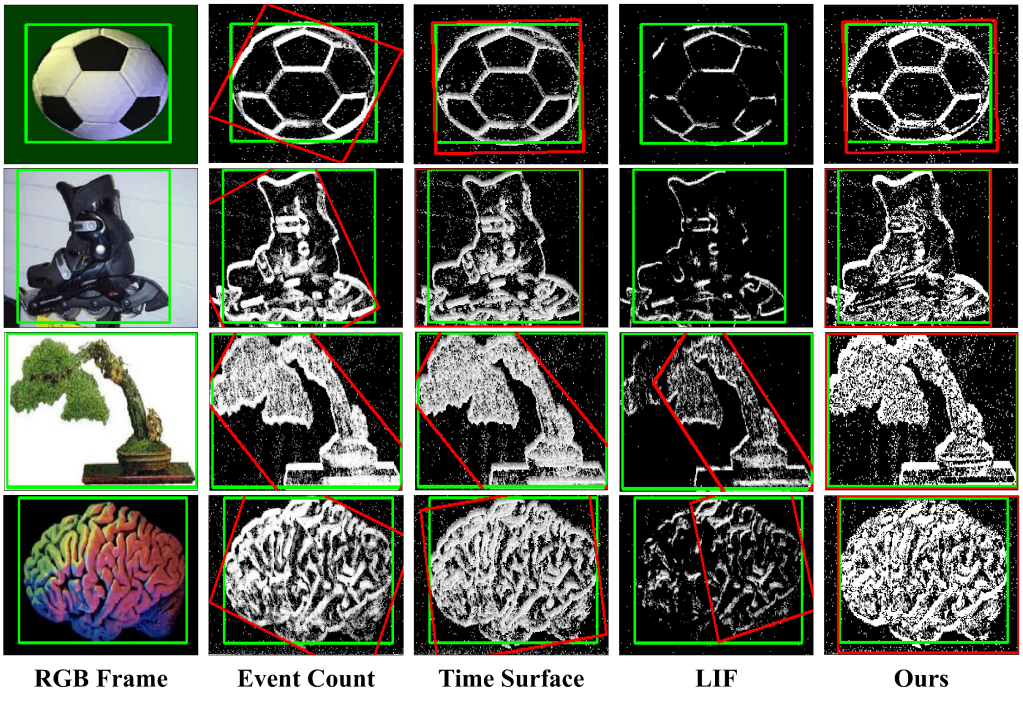
• We propose an event stream processing framework inspired by the brain’ s dorsal visual pathway. We intro duce the spatial-temporal information encoding mech anism of the brain's dorsal pathway, also known as the “where” pathway, into the event stream data processing framework, effectively establishing a high-order mapping from event streams to event frames.
• This framework utilize CCNN to encode constant polarity eventsequences as periodic signals and varying-polarity event sequences as chaotic signals, effectively achieving robust event representation. Combined with traditional deep neural network, the frame work successfully performs in object classification for event cameras.
• The proposed framework is evaluated on multiple datasets, achieving the state-of-the-art accuracy on specific benchmarks. It also demonstrates competi tive performance across a variety of datasets. The results demonstrate the framework’ s strong generaliza tion across different data structures.

Abstract

Event cameras are bio-inspired vision sensors that encode visual information with high dynamic range, high temporal resolution, and low latency. Current state-of-the-art event stream processing methods rely on end-to-end deep learning tech niques. However, these models are heavily de pendent on data structures, limiting their stabil ity and generalization capabilities across tasks, thereby hindering their deployment in real-world scenarios. To address this

issue, we proposes a chaotic dynamics event signal processing frame work inspired by the dorsal visual pathway of the brain. Specifically, we utilize Continuous coupled Neural Network (CCNN) to encode event stream. CCNN encodes polarity-invariant event sequences as periodic signals and polarity changing event sequences as chaotic signals. We then use continuous wavelet transforms to analyze the dynamical states of CCNN neurons and derive the extraction of high-order mappings of event stream. The effectiveness of our method is vali dated through integration with conventional classi fication networks, achieving state-of-the-art clas sification accuracy on the N-Caltech101 and N-CARS datasets, with results of 84.3% and 99.9%, respectively. Our method improves the accuracy of event camera-based object classification while significantly enhancing the generalization and stability of event representation.

Visualization



Installation