

Exploring the Potentials of Spiking Neural Networks for Image Deraining

Shuang Chen¹, Tomas Krajinik², Farshad Arvin¹, and Amir Atapour-Abarghouei¹

1. Department of Computer Science, Durham University, UK

2. Artificial Intelligence Centre of Czech Technical University, Czechia

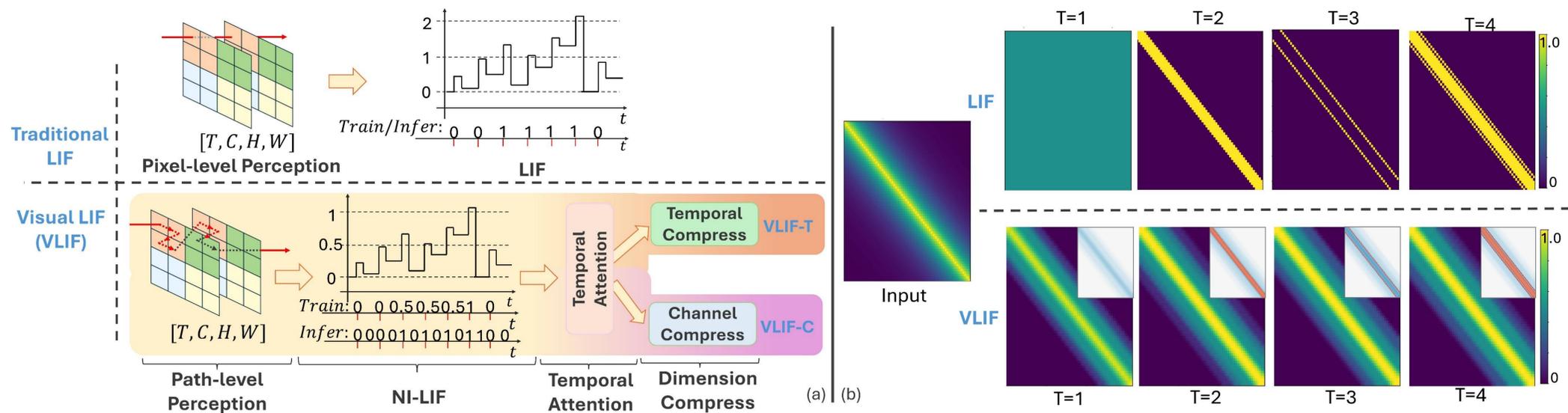


ArXiv Link



Code Link

Motivations

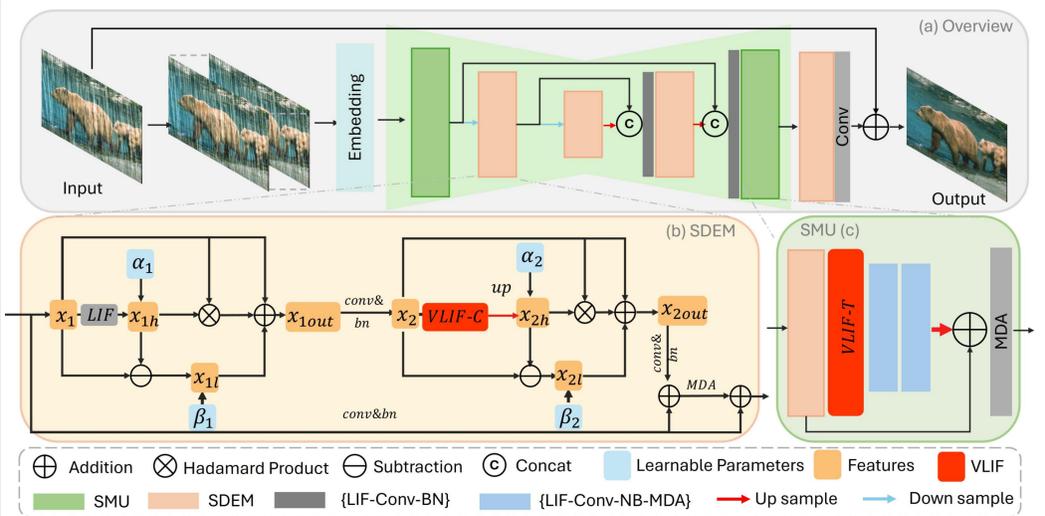


The comparison of LIF and VLIF. (a) shows differences in pipeline, (b) shows differences response areas, in the top-right insets, blue and orange denote the response for LIF and VLIF, respectively.

Main Contribution

- We provide visual perception capabilities to LIF neurons and explicitly elucidate the feature representation mechanism of conventional LIF neurons in image deraining.
- We propose the novel **Visual LIF (VLIF)**, to incorporate local visual context through spatial aggregation and continuous membrane potentials, over coming the spatial insensitivity and representational limitations of conventional LIF neurons.
- Leveraging the VLIF neuron, we introduce a novel image deraining framework comprising the proposed Spiking Decomposition and Enhancement Module (**SDEM**) and the Spiking Multi-scale Unit (**SMU**). This framework significantly surpasses the performance of the best existing SNN-based deraining models while consuming only 13% of their energy.

Overview



Results

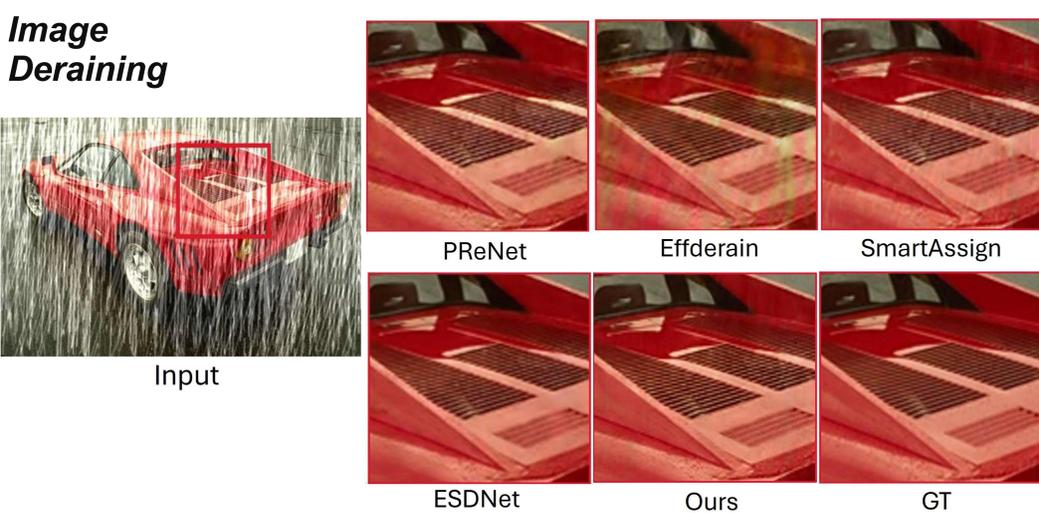
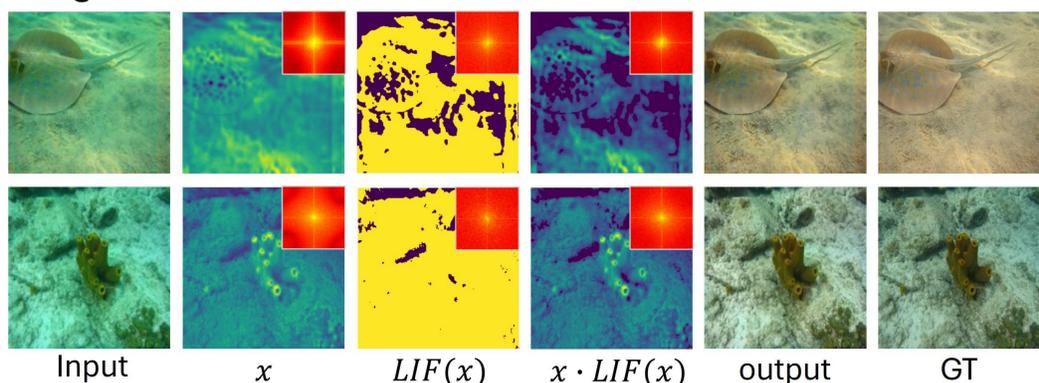
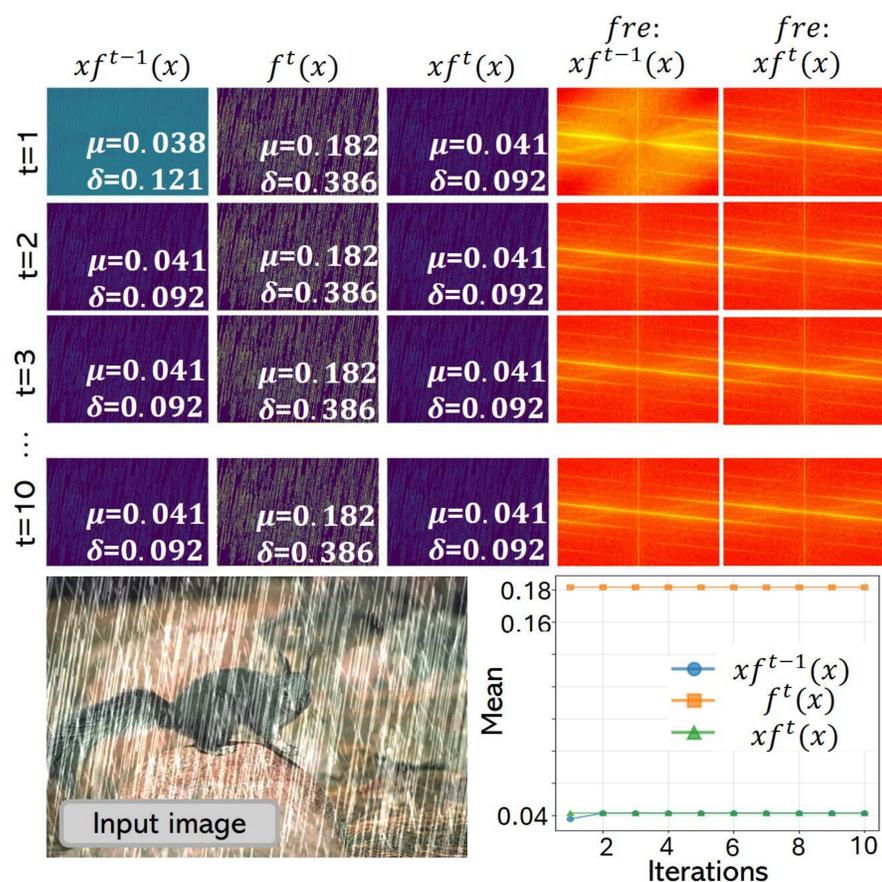


Image Underwater Enhancement



Frequency Highlighting & Frequency Saturation



LIF $f()$ highlights high-frequency rain but exhibits frequency saturation with repeated applications after $t = 1$. x is embedded features, fre is frequency spectrums.