

Synaptic Delays for Temporal Pattern Recognition

Kévin Constantin¹

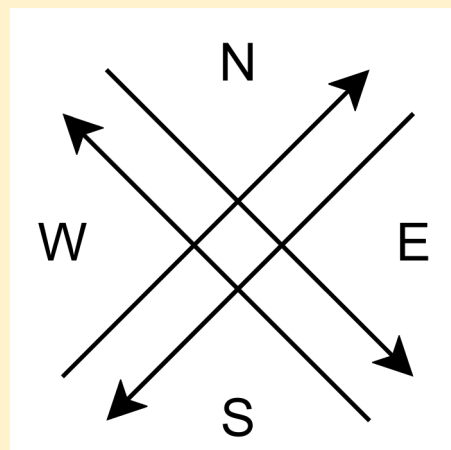
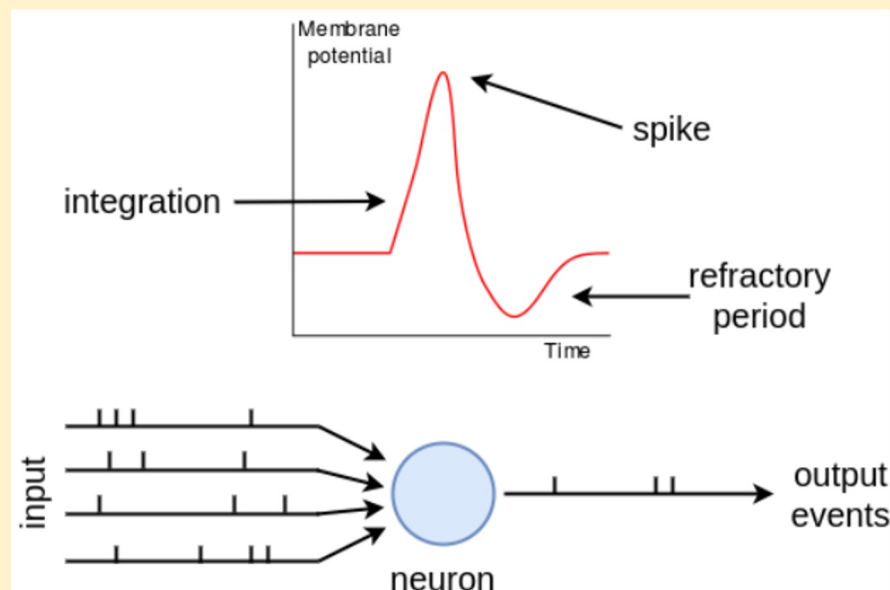
¹Polytech Nice-Sophia - France

Amélie Gruel²

²Université Côte d'Azur, CNRS, I3S - France

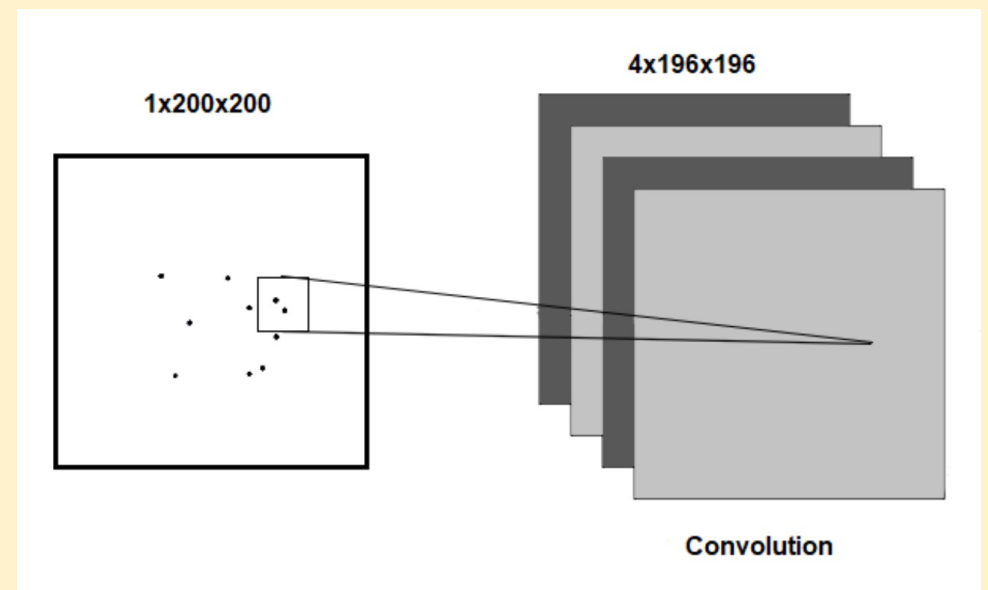
Jean Martinet²

Spiking Neural Network [Maas, 1997] & [Gruel, 2023]



Delay Learning

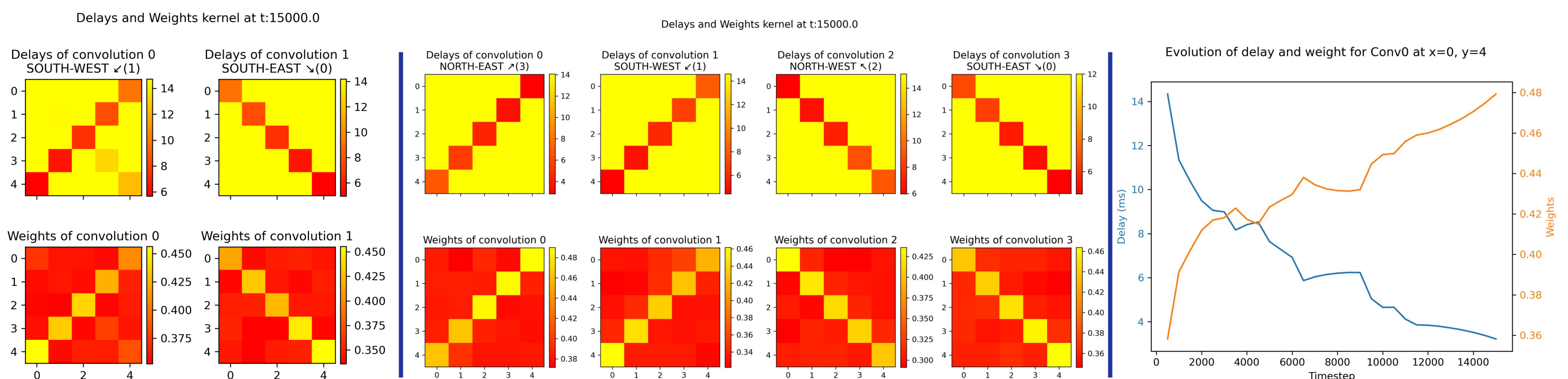
Unsupervised Delay Learning in SNN [Nadafian, 2020]



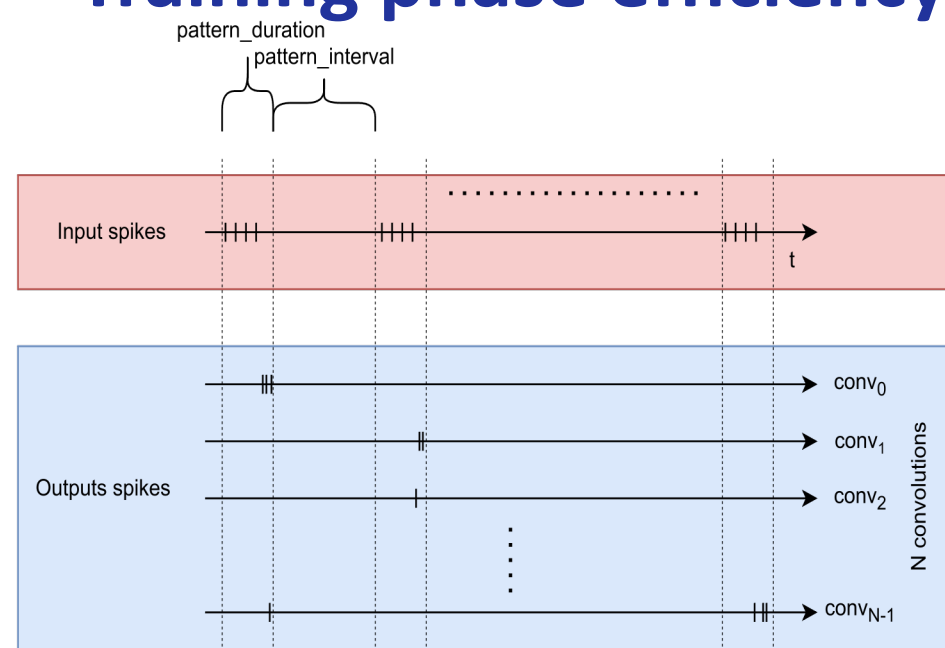
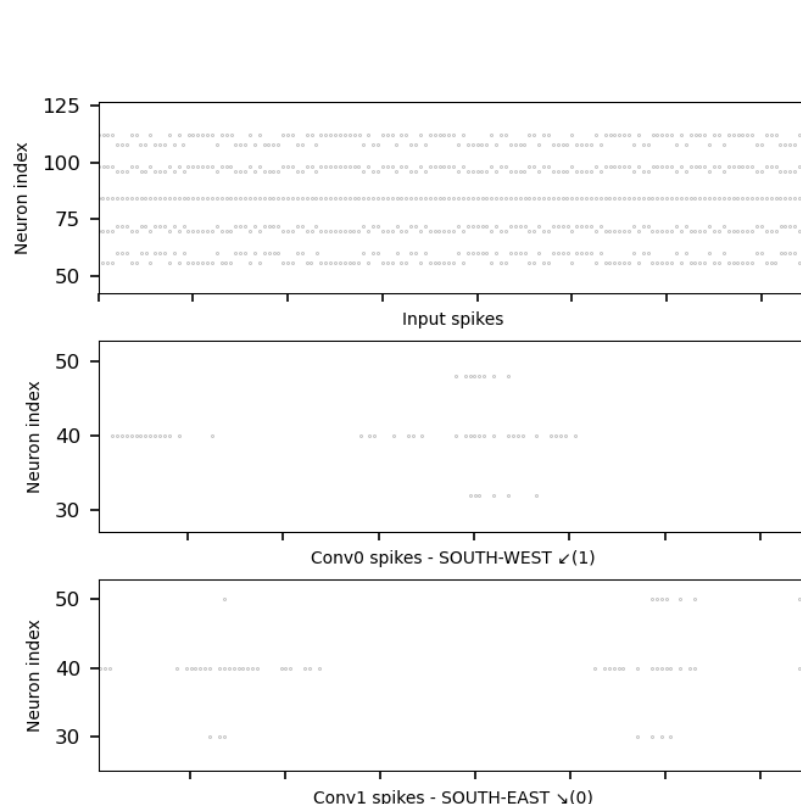
Visualizing delays and weights

Input : -135° and -45° moving dots

Input : $\pm 135^\circ$ and $\pm 45^\circ$ moving dots



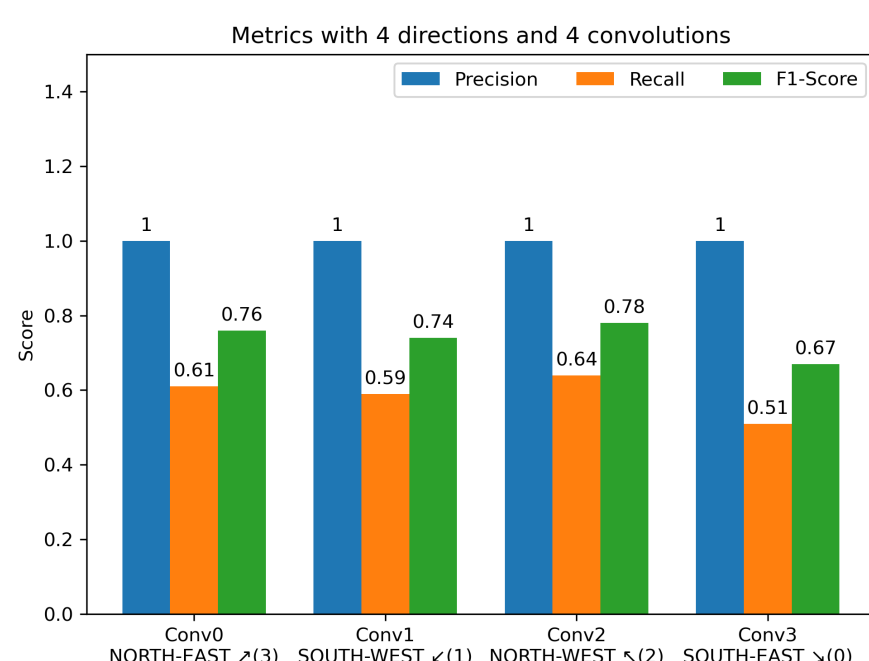
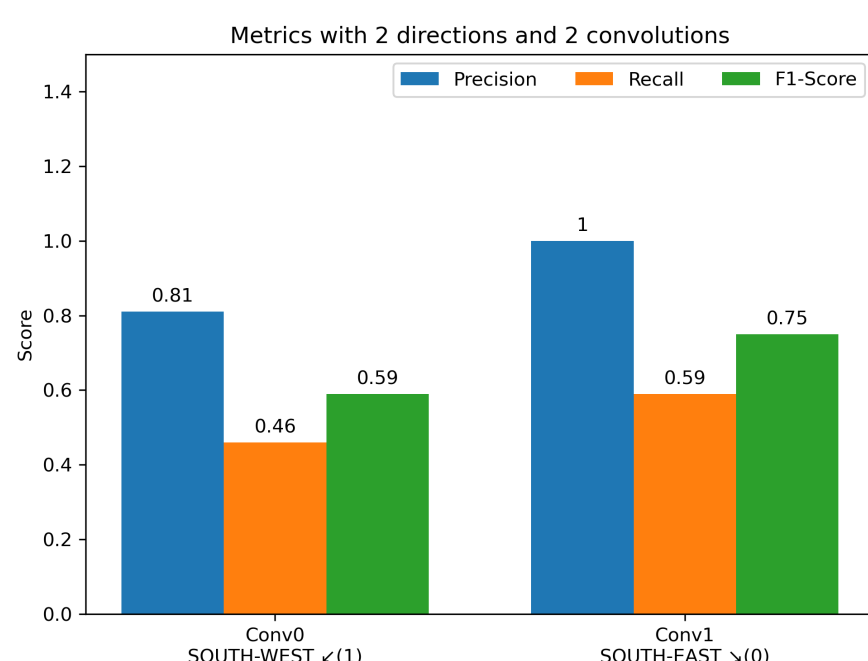
Training phase efficiency : Metrics



Precision : Correct spike rate compared to those found

Recall : Did we find every spike we should have found ?

- **True Positive** : Spike where it was supposed to be
- **False Positive** : Spike but the input motion did not correspond
- **False Negative** : No spike while the input motion corresponded



Future works

- Increase number of directions
- Results on noisy input data
- Test on real-life data (event camera)
- Implement on SpiNNaker (neuromorphic processor)

References

- [Maass, 1997] W. Maass (1997). Networks of Spiking Neurons: The third generation of neural network models. *Neural Networks*.
- [Gruel, 2023] A. Gruel, J. Martinet, B. Linares-Barranco and T. Serrano-Gotarredona (2023). Performance comparison of DVS data spatial downscaling methods using Spiking Neural Networks. *IEEE/CVF WACV*.
- [Nadafian, 2020] A. Nadafian and M. Ganjtabesh (2020). Bio-plausible Unsupervised Delay Learning for Extracting Temporal Features in Spiking Neural Networks. *arXiv [cs]*.