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A D V A N C E D   S E M I N A R  
for  
xxx, Mat.-Nr. xxx

**Theory and Applications of Tempotrons and Aggregate-Label Learning**

Problem description:

The Tempotron[1] is a feedforward spiking neural network for spatio-temporal pattern recognition. Its synaptic weights are trained by gradient descent with respect to the so-called spike-threshold-surface. Review the Tempotron[1, 2] and its recent extension the multi-spike Tempotron[3]. Concentrate on these aspects:

1. How do the learning rules work from a mathematical point of view?
2. What data do these learning rules require (and when)?
3. Can such gradient-based rules be implemented on SpiNNaker[4] within the sPyNNaker framework?
4. What are existing and possible future applications?

Bibliography:

- [1] Gütig, Robert, and Haim Sompolinsky. *The Tempotron: A Neuron That Learns Spike Timingbased Decisions*. Nature Neuroscience 9, no. 3 (March 2006): 42028. doi:10.1038/nn1643.
- [2] Gütig, Robert, and Haim Sompolinsky. *Time-WarpInvariant Neuronal Processing*. PLOS Biology 7, no. 7 (July 7, 2009): e1000141. doi:10.1371/journal.pbio.1000141.
- [3] Gütig, Robert. *Spiking Neurons Can Discover Predictive Features by Aggregate-Label Learning*. Science 351, no. 6277 (March 4, 2016): aab4113. doi:10.1126/science.aab4113.
- [4] S.B. Furber, F. Galluppi, S. Temple, L.A. Plana: *The SpiNNaker Project*. Proceedings of the IEEE, 102, 5 (2014) doi:10.1109/JPROC.2014.2304638

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