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Training physical models of deep spiking neural networks

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The nervous system accomplishes its energy-efficiency through a combination of analog computation and a sparse event-based communication. Especially the latter can pose challenges to learning or training strategies. The recent adoption of surrogate gradients, however, paved the way for an effective gradient-based training of spiking neural networks (SNNs). This talk presents a flexible and robust surrogate-gradient-based training framework for the mixed-signal neuromorphic system BrainScaleS-2. It overcomes the challenges inherent to the analog nature of the neuromorphic SNN and allows the training of multilayer networks with both feedforward and recurrent topologies. It reaches a performance on a par with software simulations on both vision and speech benchmark datasets. The framework can cope with even deliberately emphasized device mismatch and self-corrects for the resulting inhomogeneities in the neural dynamics. Finally, the combination of efficient coding schemes as well as the accelerated nature of BrainScaleS-2 yields quick inference latencies and a high classification throughput.

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