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Event-Based Eligibility Propagation with Additional Biologically Inspired Features

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Recent advances in neural plasticity research have broadened the foundational Hebbian concept by integrating additional modulating factors. Among these, eligibility propagation (e-prop) stands out as a novel approach, initially devised as an online approximation to backpropagation through time (BPTT) [1]. In this study, we present a series of novel strategies that introduce additional bio-inspired features to e-prop. Our modifications not only contribute to the realism with which e-prop mimics biological processes but also facilitate its implementation in large-scale spiking neural network simulations, thereby establishing its significance for computational neuroscience.

Our study demonstrates that the learning performance achieved with the modified e-prop method is on par with the original e-prop approach. We highlight the seamless integration of e-prop into NEST's event-driven framework for synapses, contrasting it with the original time-driven implementation. This adaptation expands e-prop's applicability for studying learning processes across biological and artificial neural networks, suggesting a broader utility in the field.

We delineate our methodological adaptations and their scalability for large-scale network simulations. Through strong- and weak-scaling analyses, we demonstrate how e-prop in NEST scales effectively for larger networks.

Acknowledgements

References

[1] Bellec, G., Scherr, F., Subramoney, A., Hajek, E., Salaj, D., Legenstein, R., & Maass, W. (2020). A solution to the learning dilemma for recurrent networks of spiking neurons. Nature communications, 11(1), 3625.

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Primary authors: KORCSAK-GORZO, Agnes (Institute for Advanced Simulation (IAS-6), Jülich Research Centre, Jülich, Germany. Department of Physics, Faculty 1, RWTH Aachen University, Aachen, Germany); STAPMANNS, Jonas (Department of Physiology, University of Bern, Bern, Switzerland); ESPINOZA VALVERDE, Jesus Andres (School of Mathematics and Natural Sciences, Bergische Universität Wuppertal, Wuppertal, Germany); DAHMEN, David (INM-6, Juelich Research Centre); VAN ALBADA, Sacha (Institute for Advanced Simulation (IAS-6), Jülich Research Centre, Jülich, Germany. Institute of Zoology, University of Cologne, Cologne, Germany); BOLTEN, Matthias (Department of Mathematics and Science, University of Wuppertal); PLESSER, Hans Ekkehard (Institute for Advanced Simulation (IAS-6), Jülich Research Centre, Jülich, Germany. Dept. of Data Science, Faculty of Science and Technology, Norwegian University of Life Sciences, Ås, Norway. Käte Hamburger Kolleg, RWTH Aachen, Aachen, Germany); DIESMANN, Markus (Institute for Advanced Simulation (IAS-6), Jülich Research Centre, Jülich, Germany. Department of Physics, Faculty 1, RWTH Aachen University, Aachen, Germany. JARA-Institute Brain Structure-Function Relationships (INM-10), Jülich Research Centre, Jülich, Germany. Department of Psychiatry, Psychotherapy and Psychosomatics, Medical Faculty, RWTH Aachen University, Aachen, Germany)

Presenter: ESPINOZA VALVERDE, Jesus Andres (School of Mathematics and Natural Sciences, Bergische Universität Wuppertal, Wuppertal, Germany)

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