

Supporting Information for “Spike Enabled Audio Learning in Multilevel Synaptic Memristor Array Based Spiking Neural Network”

Xulei Wu^{1,2}, Bingjie Dang², Hong Wang³, Xiulong Wu¹, and Yuchao Yang²

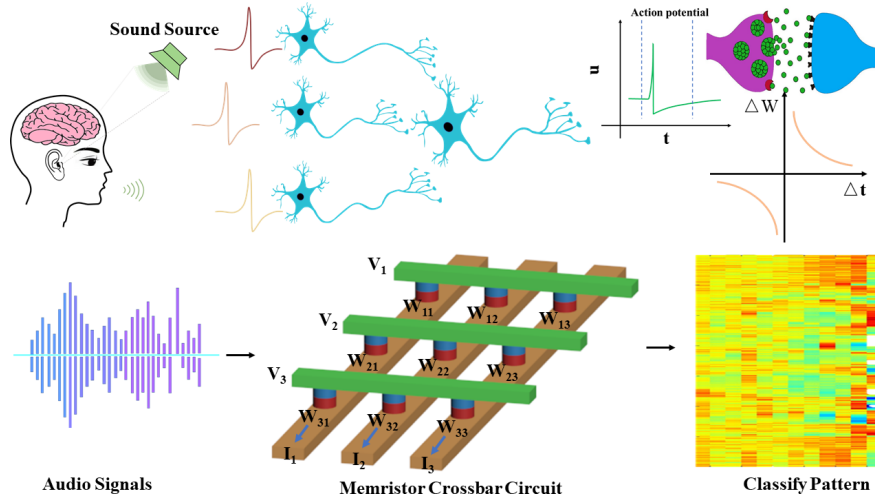
¹Anhui University

²Peking University

³Xidian University

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ToC Figure



Authors

Xulei Wu^{1,2}, Bingjie Dang², Hong Wang⁵, Xiulong Wu^{1,*}, and Yuchao Yang^{2,3,4,*}

¹School of Electronics and Information Engineering, Anhui University, Hefei 230601, China.

²Key Laboratory of Microelectronic Devices and Circuits (MOE), School of Integrated Circuits, Peking University, Beijing 100871, China.

³Center for Brain Inspired Chips, Institute for Artificial Intelligence, Peking University, Beijing 100871, China.

⁴Center for Brain Inspired Intelligence, Chinese Institute for Brain Research (CIBR), Beijing, Beijing 102206, China.

⁵Key Laboratory of Wide Band Gap Semiconductor Technology, School of Advanced Materials and Nanotechnology, Xidian University, Xi'an, 710071, China

Abstract

Although speech recognition has been widely implemented in software neural networks, a hardware implementation based on energy efficient computing architecture is still missing. In this study, we have fabricated W/MgO/SiO₂/Mo memristor array with multilevel resistance states, where the weights of the artificial synapses in the memristor array can be tuned precisely by voltage pulses. Based on the array, we have performed speech recognition in memristive spiking neural network (SNN) with improved supervised tempotron algorithm on TIDGITS dataset, demonstrating software-comparable accuracy for speech recognition in the memristive SNN. We envision that such memristive SNN can pave the way to building a bio-inspired spike-based neuromorphic system for audio learning.

Supporting Information

The Maximum-Margin Tempotron algorithm is a kind of modified the classical tempotrons by introduced a hard margin [?] add to the firing threshold V_{th} . We found adopt it, the classification accuracy of SNN increase about 2%. Furthermore, we investigate its effect on the classification accuracy using the TIDGITS dataset by increasing [?] from 0 to 1 with an interval of 0.1. As shown in Figure S1a, the hard margin [?] improves the classification accuracy below [?] = 0.7, and the best accuracy is achieved with a value of 0.5. What's a more, we perform experiments with different number of activated output neurons in the SOM for each sound frame. With more activated output neurons, the SNN achieves lower classification accuracy, as shown in Figure S1b. The results show the number of neurons activated output neurons in the SOM has a greater effect on accuracy by the means of hardware than software.

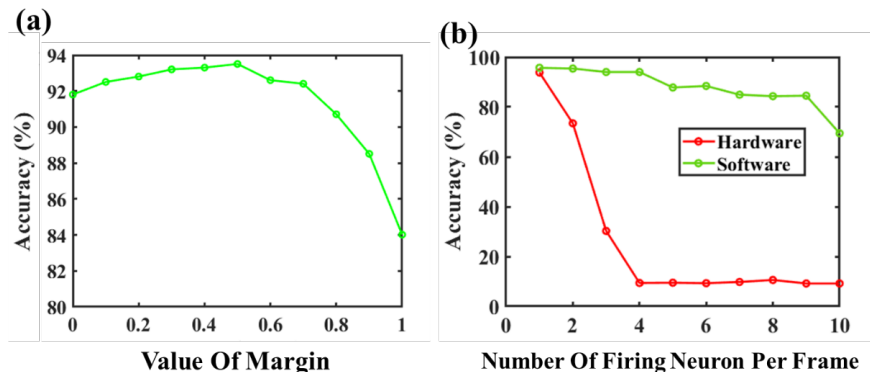


Figure S1. (a) The effect of the hard margin [?] on classification accuracy. For [?]=0, the modified learning rule is reduced to the classical Tempotron rule. (b) The effect of the number of activated output neurons in the SOM for each sound frame.

Link

movie 1 : <https://youtu.be/tmy9bfasjZU>

movie2 :https://youtu.be/y_WFbKq4Jw4