To the best of our knowledge, STAND-Net represents the first application of spiking neural networks to EEG artifact removal tasks. As there are currently no publicly available SNN-based baselines for this task, we constructed two comparative SNN variants by converting existing deep neural networks into their spiking equivalents using the same training framework: (1) an SNN variant of FCNN (denoted as FCNN-S); and (2) an SNN variant of 1D-ResCNN (denoted as 1D-ResCNN-S).

The performance metrics of these two variants, along with STAND-Net, are summarized in Table I. The results show that the conversion from traditional DNNs to SNNs consistently improves denoising performance across all indicators (RRMSE, SNR, PSNR, WSNR, and CC), validating the intrinsic advantage of spike-based computation for neural pulse signal processing. Furthermore, STAND-Net achieves the best performance among all SNNs, demonstrating its superior capability in artifact removal and signal reconstruction.

We believe that these supplementary comparisons strongly confirm the effectiveness and superiority of STAND-Net as a neuromorphic solution for EEG artifact removal.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | **Artifacts** | **RRMSE** | **SNR** | **PSNR** | **WSNRe** | **WSNRh** | **CC** |
| FCNN-S | EMG | 0.4734 | 6.8736 | 17.8123 | 8.5119 | 9.1326 | 0.8708 |
| EOG | 0.3628 | 8.4247 | 17.2528 | 9.1033 | 10.7024 | 0.9308 |
| ECG | 0.3683 | 13.4169 | 20.8739 | 12.8102 | 12.9819 | 0.9469 |
| EMG+EOG | 0.3579 | 9.0132 | 19.5510 | 10.6863 | 10.6585 | 0.9334 |
| EMG+ECG | 0.2101 | 13.7263 | 24.3220 | 14.4275 | 15.3642 | 0.9801 |
| EOG+ECG | 0.4431 | 7.2776 | 17.6815 | 8.1824 | 8.1056 | 0.8954 |
| EMG+EOG+ECG | 0.4739 | 6.8335 | 17.2024 | 7.9643 | 7.8708 | 0.8804 |
| 1D-ResCNN-S | EMG | 0.5168 | 5.9454 | 16.2058 | 7.5343 | 7.0292 | 0.8554 |
| EOG | 0.3076 | 10.5902 | 20.8466 | 13.1498 | 14.7454 | 0.9367 |
| ECG | 0.3987 | 8.3402 | 18.6056 | 9.7662 | 10.8116 | 0.9173 |
| EMG+EOG | 0.5349 | 5.5195 | 15.7962 | 7.4473 | 7.3062 | 0.8463 |
| EMG+ECG | 0.4306 | 7.5572 | 17.857 | 8.9923 | 10.0842 | 0.9032 |
| EOG+ECG | 0.5728 | 4.9024 | 15.1624 | 6.0512 | 5.8448 | 0.8219 |
| EMG+EOG+ECG | 0.5608 | 4.7868 | 15.0252 | 6.3214 | 6.2648 | 0.8134 |
| STAND-Net | EMG | 0.2235 | 15.4902 | 23.0426 | 14.1333 | 13.8122 | 0.9673 |
| EOG | 0.1745 | 17.1081 | 23.1624 | 16.9776 | 17.7475 | 0.9744 |
| ECG | 0.1526 | 16.9952 | 27.0477 | 17.5021 | 18.1516 | 0.9879 |
| EMG+EOG | 0.2091 | 14.6755 | 24.7269 | 15.8603 | 15.6735 | 0.9614 |
| EMG+ECG | 0.1444 | 17.2862 | 27.3301 | 17.8603 | 18.5077 | 0.9899 |
| EOG+ECG | 0.2348 | 15.3643 | 23.408 | 14.4361 | 14.1796 | 0.9722 |
| EMG+EOG+ECG | 0.2131 | 16.5214 | 24.0844 | 15.1284 | 14.9431 | 0.9785 |

Table I Comparison of STAND-Net with other SNNs