Modeling of ferroelectric and negative capacitance FDSOI transistors, Part II: Towards Neuromorphic applications

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Abstract

In this seminar, A leap towards deriving a robust-compact model for ferroelectric-FET (FeFET) oscillator based spiking neurons has been developed. The compact model can capture and emulate neurons that exhibit both excitatory and inhibitory coupled dynamical behaviour, native to cortical neurons. The proposed model can reliably mimic neuronal dynamics for a broad-spectrum of FeFETs when, factored with appropriate validation of numerical simulations and physics-based models. The emulation of neuronal attributes based on FDSOI FeFET having qualitative agreement with previously reported data. The robustness of this analytical model has been investigated by tuning with ferro-dielectric (Fe) materials i.e., zirconium-doped HfO_2 (HZO) and silicon-doped HfO_2 (HSO) for mimicking the neurons. In continuance, the model is examined for emulating the cortical neurons by altering the inhibition (high-V_{GF}) and excitation (low-V_{GF}) inputs with a suitable frequency of operation for spiking neurons.

Furthermore, the robust-compact model based on FeFET-MOSFET oscillator based spiking neurons is investigated for external temperature effects. The compact model is tuned to reliably mimic regular spiking type cortical neurons with HZO and HSO based FeFET(s). The analytical simulations has shown alterations at FeFET oscillations and no visible changes in the digital spikes output for the regular spiking type cortical neurons dynamics.