CIRCUIT THEORY APPROACH OF A SUBTHRESHOLD MOS NEURAL NETWORK WORKING AS WTA

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We study the classical Lazzaro circuit, the analog MOS network which can perform rank selection tasks. The circuit has N currents as inputs and N voltages as corresponding outputs and is of feedback type with a common control current. Its use in neural computation is based on the simplicity of VLSI manufacture and on large applications in low power signals as those of biological sensors. Therefore, we discuss the dynamic model built with MOS transistors in subthreshold region. We emphasize on rigorous conditions keeping the devices inside that region for all transient duration, a consistency requirement which seems neglected so far. Then we study the W(inner) T(ake) A(ll) function of the circuit in the following steps: first, we prove lower and upper bounds for each output voltage rank, by indicating the corresponding list of input currents. Second, we prove that the maximum of u_2 (second voltage component) surpasses the minimum of u_1. This apparently voids the WTA functioning. Third, we show that this mismatch can be squeezed as much as we want by a proper choose of maximum input allowed and the control current value. These parameters depend on the list length and density. Hence, our circuit can select the maximum of a list with a prescribed precision by signaling the rank over a computable threshold.

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