Resistive switching devices are originally developed for non-volatile memory applications. However, it has been shown that such “memristive” devices can be efficiently used to perform logic operations as well [1]. This enables an interesting alternative concept to do computation. Indeed, the standard computation machine using transistor-based logic has the von-Neumann structure with separate memory and computation processing unit (CPU), and suffers from the so-called memory bottleneck as both operation speed and energy consumption become dominated by the transfer of the data from the memory to the CPU and back. Memristive devices, because of their non-volatility, can be used to perform logic-in-memory (LiM) where the computation is done inside the memory array itself, without the need of uploading the input data or storing the output data.

Different “types” of memristive based logic have been presented, as Implication logic [1], CRS logic [2], You logic [3], MAGIC [4], and others. These different logic types differ in e.g. array compatibility and “statefulness”, and if the output is stored in the same location as the input or not; all affecting their possible application.

Typically, these logic concepts are demonstrated “conceptually”, i.e. using ideal memristive device operation assumptions and simplified models, and not implemented in a real (large) array. Hence, it remains of critical importance to evaluate how these types of logic function using real devices and/or in realistic array configurations [5,6].

We will present an overview of different memristive logic types, as well as give examples of the effects of realistic device parameters and array configurations for different logic types, based on physics based operation models [7] of experimental ECM and VCM type of ReRAM devices [8].

Keywords: Memristive Devices, Logic in Memory, ReRAM

References:


Presenting author’s email: wouters@iwe.rwth-aachen.de