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Behavioural Simulator for YFlash Analog Crossbar Array

Yflash is a memory device manufactured by Tower Semiconductor that consists of two transistors in series with a common drain and floating gate. This device can be used as an analogue memory element in its subthreshold region of operation and can have up to 65 stable conductance levels. When placed in a crossbar, this device can be used for various analogue brain-inspired computing applications like Hopfield networks, deep belief networks and artificial neural networks.

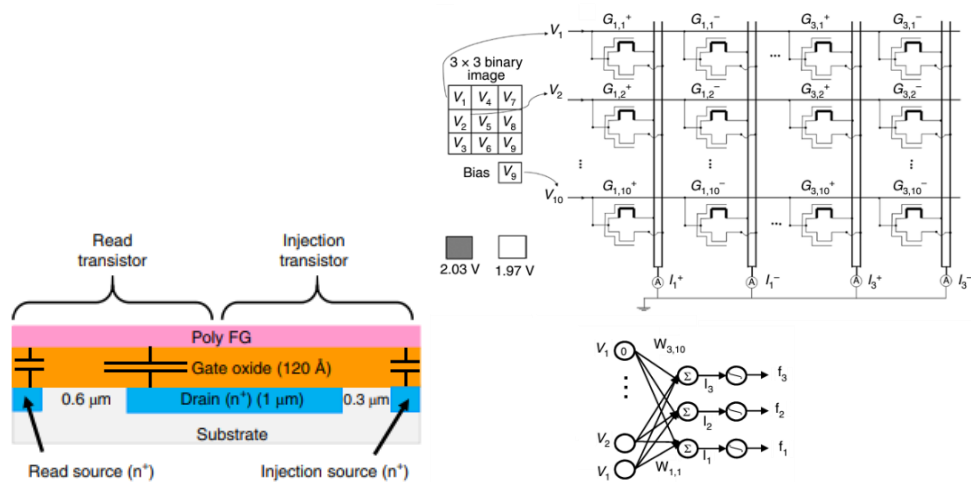


Figure 1 (a) Yflash device structure (b) Yflash crossbar array for ANN[1]

In this project, you will build a behavioural simulator of a Yflash crossbar array using MATLAB or python. This simulator must be able to model the behaviour of a real YFlash array. The crossbar must be scalable.

You will use this crossbar model for building a multilayer perceptron (MLP) type artificial neural network (ANN) and demonstrate its usage for handwritten digit recognition. You will then explore the scalability of YFlash arrays using larger datasets. You will also explore the scalability of the MLP ANN using multiple fixed size YFlash crossbars.

Software: MATLAB or Python

Courses: Electronic Circuits (044137)

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Reference:

- [1] L. Danial et al., "Two-terminal floating-gate transistors with a low-power memristive operation mode for analogue neuromorphic computing," Nature Electronics, Vol. 2, No. 12, pp. 596–605, December 2019.