Nanoelectronic Challenges and Opportunities for Cyber-Physical Systems

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***Abstract*—Over the last decades nanoelectronics have face an unprecedent evolution. Not only have the so-called conventional devices faced the development of new Mosfet device structures enabling the implementation of ever smaller device sizes operating at higher frequencies, but new unconventional devices have emerged as well. Also, the possibility of integrating intelligent nano sensors and actuators yields the possibility to modify our everyday life through cyber-physical systems. On the other hand, the application of these cyber-physical systems to a wide range of application domains, is also fueling the development of new devices with ever demanding specifications. This paper deals with the opportunities and challenges for nanoelectronics in their application in Cyber-physical systems**

***Keywords*—Nanoelcetronics, compact modeling, prameter extraction, VerilogA, Cyber-Physical Systems**

I. INTRODUCTION

During the last decades the evolution of nanotechnologies has yielded the development of advanced components enabling the implementation of electronic equipment with increased capabilities, better performance, lower power consumption, and smaller form factors. Applications have moved from being stationary to becoming portable and wearable by people. More recently, the possibility for designing intelligent nano actuators/ sensors that can be integrated in communicating objects, capable of generating, exchange, and consume data with minimum human intervention, has made possible the "Internet of Things." More recently the evolution of nano technology has made possible the birth of Cyber-Physical (CPs) systems involving other physical objects such as wearable devices, vehicles, homes, buildings, and even energy systems, in which continuous sensing and computing takes place[1].

The innovation and development of CPs relies on the input of many disciplines, and Nano Electronics is expected to be a key enabling technology (KET) to sustain the development of future smart sensing systems and/or Cyber-Physical Systems. In this paper the challenges for nanolectronics arising from the increased domains of application of CPs is addressed. Starting from an overview of nanoelectronics evolution, from conventional MOSFET transistors, different MOSFET structures for CMOS devices till what is usually referred to as non-conventional Nano devices, the need for developing advanced modelling techniques at different abstraction levels is pointed out. For the different levels, challenges for the development of the models are identified. In particular, the automatic evaluation of model parameters given data resulting from measurement of devices characteristics, is analysed and a working example considering the automatic determination of TFT model parameters is illustrated[2]. The high accuracy of results obtained is demonstrated by comparing the output characteristics of a TFT with W/L=50/20 [μm] obtained with the model, against those obtained from measurements (in doted), as illustrated in Fig. 1. Finally, the specificity of using VerilogA in the development of device models to be integrated into electrical simulators is considered. The case for a nonconventional device, i.e. a memristor, model is presented, and results illustrating the transient simulation in spectre of the device in both soft and hard regimes are presented.

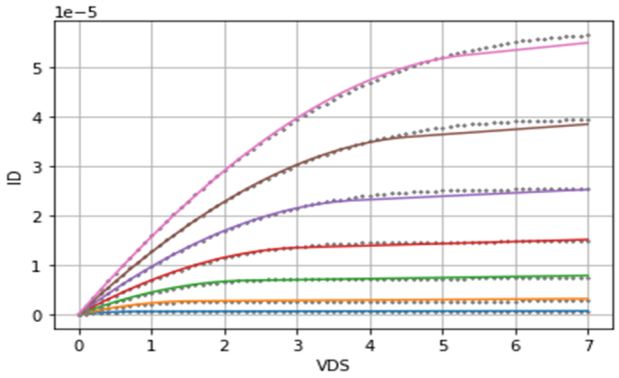

Fig. 1. TFT Output characteristics.

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