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Parameter determination in MOSFETs transitors based on Discrete Orthogonal Chebyshev polynomials

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Abstract

Transistors, and in particular MOSFETs (Metal Oxide Semiconductor Field Effect Transistors), are the most used basic building blocks of integrated circuits (ICs). The complexity of current chips makes essential their accurate characterization to use them for circuit design purposes. For each generation of transistors the main electrical features have to be modeled in order to reproduce them as a function of the voltages differences applied between their terminals. The models (usually known as compact models) consist of a set of analytical equations and a set of parameters to include in those equations. A different set of parameters is used for each fabrication technology. These models are used in TCAD circuit simulation tools and also for hand-calculations used at the first stages of circuit design.

The extraction of the parameters of new technologies is essential since the capacities of circuit designers are dependant on the accuracy of model parameters that in many cases are linked to important physical effects.

Each parameter is obtained in a different way. However, few of them share some features in common, at least from the numerical viewpoint. In this respect, several parameters are obtained by means of extrapolation methods (for example threshold voltage calculation), linear regression (determination of the body factor), slope calculations (extraction of the DIBL parameter), etc. In all these procedures, the determination of portions of curves that can be approximated by a straight line is crucial. In this work we just deal with this issue trying to shed light by means of advanced numerical techniques.

We have developed a method to determine the number of straight line portions contained in a curve in an automatic manner. The algorithm developed, based on discrete orthogonal polynomials, can be used for parameter extraction purposes. It consist on the isolation of straight line portions in experimental or simulated data and the determination of the slope of those curve sections to calculate one or more parameters of a compact model.

Key words: Discrete orthogonal polynomials, straight line portion, MOSFET.