Noise-Aware Power Optimization Technique for MTCMOS Circuits

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ABSTRACT

Subthreshold leakage current and crosstalk noise are two important issues of integrated circuits in nanometer technology node. MTCMOS (Multi-Threshold CMOS) is a technology that allows the devices in a circuit to be with different threshold voltages (VTH). It is used to assign the devices on the timing critical path with low VTH to preserve the high performance and assign the devices on the non-critical path with high VTH to reduce the leakage. This is an effective way to achieve high performance and low power goal by adequately assigning the threshold voltage of each device in a circuit. In this paper, we take the above mentioned two issues into consideration. With considering the crosstalk and leakage issues simultaneously, we have the following observation. If the input signal of a device on the critical path has the crosstalk noise problem, then the device should be assigned with high VTH since high VTH device is less sensitive to noise. We propose an algorithm based on the above observation. We first extract the coupling capacitances of aggressor and victim nets from the standard-cell-based layout of a circuit. Then, crosstalk noise analysis is performed to find out the nets with larger noise which is measured by the “ maximum peak voltage ”. The second step is to identify the critical path. By the results of the above steps, we globally assign each cell with either high-Vth or low-Vth version from the cell library to achieve the noise-aware and low-power design goal. Experiments are performed on the circuits from the ISCAS89 benchmark suite. First, the circuit is implemented using the TSMC 0.13um dual threshold standard-cell library. Then, the commercial tool SOC Encounter is used to perform the placement and routing work and crosstalk analysis of the circuit. After applying our proposed algorithm, we can reduce the number of nets with noise greater then VDD*10% about 17%.

Keywords : Low-Power ; Design ; Leakage ; MTCMOS ; Crosstalk noise

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