عنوان مقاله:

Adaptive Energy-Efficient Variation-Aware Dynamic Frequency Management

محل انتشار:

مجله نوآوری های مهندسی برق و کامپیوتر, دوره 10, شماره 2 (سال: 1401)

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خلاصه مقاله:

kground and Objectives: Considering the fast growing low-power internet of things, the power/energy and performance constraints have become more challenging in design and operation time. Static and dynamic variations make the situation worse in terms of reliability, performance, and energy consumption. In this work, a novel slack measurement circuit is proposed to have precise frequency management based on timing violation measurement.Methods: Proposed slack measurement circuit is based on measuring the delay difference between the edge clock pulse and possible transition on path end-points (primary outputs of design). The output of proposed slack monitoring circuits is a digital code related to the current state of target critical path delay. In order to convert this digital code to equivalent delay difference, the delay of a reference gate is mandatory which is basic unit in proposed monitor. This monitor enables the design to have more precise and efficient frequency management, while maintaining the correct functionality regarding low-power mode. Results: Applying this method on a MIPS processor reduces the amount of performance penalty and recovery energy overhead up to ۳۰% with only ۲% additional hardware. Results for benchmark applications in low-power mode, show ۷-۳۰% power improvement in normal execution mode. If the application is resilient against occurred errors duo to timing violations, proposed method achieves ۲۰-۶۰% power reduction considering approximate computation as long as application is showing resilience. The performance of proposed method depends on the degree of application resilience against the timing errors. In order to keep generality of propsoed monitor for different applications, the resilience threshold is user programmable to configure according to the requirements of each application.Conclusion: The results show that precise frequency scheduling is more energy/power efficient in static and dynamic variation management. Utilizing a proper monitor capable of measureing the amount of violation will help to have finer frequency management. At the other hand, this method will help to use the resilience of application according to estimation about the possible error value based on measured vilation amount.

کلمات کلیدی:

Timing Slack Monitoring, Negative Slack Measurement, Clock Stretching, Frequency Scaling, ultra-low-energy