On Jitter in Very Long Ring Oscillators

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Abstract

This paper presents various measurements of a very long ring oscillator (10001 inverters) on a XILINX Artix FPGA. Although not relevant for practical applications, the length of the ring oscillator allows measuring properties easily, which are difficult to observe on short ring oscillators. Both the permanently oscillating and restarting modes of use for the ring oscillator are considered.

One of the properties studied is the accumulation of jitter. The paper compares jitter accumulated during the first quarter period of the ring oscillator with the jitter accumulated during the first half period of the ring oscillators. Up to the end of the first half period, the cyclic structure of the ring is not relevant, no inverter has changed its state more than once, hence no memory effects of the inverters can cause any dependencies of the jitter. Of course, the accumulation of jitter beyond the first half period was also measured.

As a practical by-product of the paper, a method to avoid setup- and hold-time violations when sampling ring oscillators of moderate length in real word applications is suggested.