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INNOVATION ADVANCEMENT & COMMERCIALIZATION

Vernier Ring Time-To-Digital Converter

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Reference: Vernier Ring TDC

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Overview

Auburn University is seeking licensees for a new time to digital converter (TDC) technology with a very fine time resolution. High resolution TDCs are popular for time-of-flight measurement, jitter measurement, clock data recovery, measurement and instrumentation, and digital phase-locked loops.

Advantages

- Larger detectable time range between signals
- Better time interval resolution
- Smaller integrated circuit die size
- Lower power consumption

Description

A time-to-digital converter (TDC) converts sporadic signal pulses into a digital measure of time. Many current TDC's use delay gates arranged in a chain to measure time between events. The first event signal starts a signal propagating down the delay chain while recording the number of gates propagated through. The second signal event stops the recording and the digital time interval is then calculated by multiplying the delay time of the gates by the number of gates travelled through. However, the resolutions on these basic delay gate TDC's are limited by the delay of the gates which have to be rather large in order to keep size to a reasonable level.

More precise TDC's have a pair of Vernier delay lines, one being called the lead line and the other the lag line. The first signal event starts the lead (slow) chain and the second event starts the lag (fast) chain. The time interval is then calculated when the lag line passes the lead line and by knowing the propagation time of both sets of delay gates. However, since measuring larger time intervals requires longer chains and more power consumption, the Vernier delay system is limited by its range and size.

Auburn's novel Vernier Delay Ring system uses two series of delay gates in a ring with one being the lead and the other the lag chain. By arranging the delay chains in a ring, it allows for precise measurements of large magnitudes while still occupying a small area by allowing the signal to circulate around the ring and reuse delay gates while entering the values into a comparator matrix. Auburn's Vernier Ring saves space and power while still allowing for very fine resolutions and large time ranges. The Vernier Ring TDC combines the versatility of delay chains with the precision of Vernier Line TDC's.

Reference

J. Yu, F. F. Dai, and R. C. Jaeger, "A 12-bit Vernier ring time-to-digital converter in 0.13µm CMOS technology," in IEEE Journal of Solid-State Circuits Vol. 45, No. 4, April 2010. ([Read](#))

Licensing Opportunities

- Issued US Patent [8,138,958](#)
- This patent is available for [immediate non-exclusive licensing](#) through Auburn's customizable "[Ready to Sign](#)" licensing program.
- Similar patents are available in the [Electronics field](#).

