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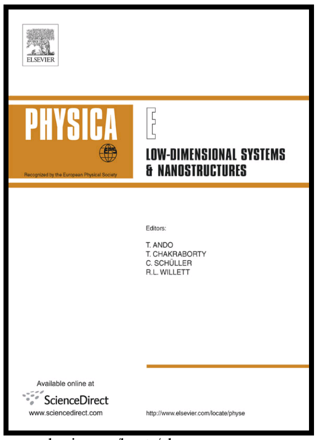

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PII: S1386-9477(16)30179-5
DOI: http://dx.doi.org/10.1016/j.physe.2016.04.007
Reference: PHYSE12402

To appear in: *Physica E: Low-dimensional Systems and Nanostructures*

Received date: 17 December 2015
Revised date: 4 April 2016
Accepted date: 5 April 2016

Successive Approximation-Like 4-bit Full-Optical Analog-to-Digital Converter based on Kerr-like Nonlinear Photonic Crystal Ring Resonators

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Abstract

Implementing of photonic sampling and quantizing analog-to-digital converters (ADCs) enable us to extract a single binary word from optical signals without need for extra electronic assisting parts. This would enormously increase the sampling and quantizing time as well as decreasing the consumed power. To this end, based on the concept of successive approximation method, a 4-bit full-optical ADC that operates using the intensity-dependent Kerr-like nonlinearity in a two dimensional photonic crystal (2DPhC) platform is proposed. The Silicon (Si) nanocrystal is chosen because of the suitable nonlinear material characteristic. An optical limiter is used for the clamping and quantization of each successive levels that represent the ADC bits. In the proposal, an energy efficient optical ADC circuit is implemented by controlling the system parameters such as ring-to-waveguide coupling coefficients, the ring's nonlinear refractive index, and the ring's length. The performance of the ADC structure is verified by the simulation using finite difference time domain (FDTD) method.

Keywords: Full-Optical Analog-to-Digital Conversion (ADC); Kerr effect; Third Order Nonlinear Susceptibility; Photonic Crystal; Ring Resonator.

1. Introduction:

In the real world, most of the signals are either continuous in time or amplitude. For digital processing, analog-to-digital (A/D) converter must be used to process these continuous signals. As communication bandwidth continuously grow, higher performance fiber systems and faster