interview

Dr Niksa Tadic

‘A generator based on a random physical phenomenon is the only method to obtain true random numbers’

Dr Niksa Tadic from the University of Montenegro talks to us about the work behind the paper ‘A 100 MHz current generator with $T/(T-t)$ time waveform in 0.35 µm BiCMOS technology model’, page 744.

Tell us a little bit about your field of research

In 1995, after three years of industrial experience, I joined the University of Montenegro, Faculty of Electrical Engineering. I am interested in optoelectronic integrated circuit design including optical receivers with variable transimpedances, red-green-blue optical sensors, and current drivers for laser diodes in both CMOS and BiCMOS technologies.

What particular applications are you interested in?

At the moment, together with my colleagues from the EMCE Institute in Vienna and the University of Montenegro in Podgorica, I am working on negative resistance based voltage amplifiers. The small-signal amplification approach based on the shifting of a DC operating point along the linear part of the voltage amplifier’s transfer characteristic has become questionable in deep submicron technologies. The slope of the linear part of the amplifier’s transfer characteristic reduces with the decrease of transistors dimensions, causing decrease of the voltage gain. The nonlinear small-signal amplification method based on negative resistance could be used as an alternative to the linear approach.

What advances have you reported in your *Electronics Letters* paper?

I have reported in *Electronics Letters* a design of a current generator suitable for optical quantum random number generation (OQRNG), designed in 0.35 mm BiCMOS technology, with $T/(T\text{-}t)$ time dependence. Logarithmic converter and differentiator used in an existing design have been avoided in the proposed design by using the BJT translinear loop. The achieved frequency bandwidth of the current pulses of 100 MHz is 5 times larger in comparison to the state-of-the-art, with at least 20 times smaller power consumption. The relative error of the measured waveform at 20 MHz is less than 3% in 97.5% of the time interval in which the current pulses have a rising slope.

What are the applications for the research covered in this Letter?

A generator based on a random physical phenomenon is the only method to obtain true random numbers. OQRNG based on the randomness of detecting single photons is of special interest because of its fast generation of random numbers and reliability. Hence, the proposed current generator with $T/(T\text{-}t)$ time dependence can be applied in all those fields where true random numbers are needed, such as cryptography, statistical analysis, numerical simulations, or lottery games.

What are you working on now?

In addition to the mentioned negative resistance based voltage amplifiers, I am working on further improvement of the OQRNG based on the proposed current generator with $T/(T\text{-}t)$ time dependence.

How has the field changed since you’ve been working in it?

During the last 12 years of my research in optoelectronics, among the other specific applications in the field, there have been efforts toward research and development of optical detectors of various types (especially photodiodes), optical receivers with variable transimpedances intended for the universal optical storage systems (CD, DVD, Blu-Ray), colour sensors, and optical distance measurement systems. In the future, without any doubt, one of the main research interests in the field of optoelectronics will be the systems for detection of weak optical signals based on single photon avalanche diodes (SPADs).

What are the challenges that will need to be met for this development to happen?

When a single photon is absorbed in the space-charge region of the SPAD, an electron-hole pair is generated. Due to the high electric field, additional electron-hole pairs are generated causing the rapid rise of the avalanche current. The avalanche current must be quenched to allow the detection of the next photon. To provide data transfer based on weak optical signals in the GHz region, the quenching of the avalanche current should be performed very fast, typically within 1 ns. This task is a great challenge for researchers in this area.

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