LOGIC CODES GENERATION AND TRANSMISSION USING AN ENCODING-DECODING SYSTEM

D. Gifany [1], I. S. Amiri [2], M. Ranjbar [3], J. Ali [2]
[1] Faculty of Engineering and Technology, Multimedia University (MMU), Melaka, Malaysia
[2] Institute of Advanced Photonics Science, Nanotechnology Research Alliance, Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru, Malaysia
[3] Faculty of Electrical Engineering, Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru, Malaysia

ABSTRACT

Nonlinear behaviors of light such as chaos can be observed during propagation of a Gaussian laser beam inside a single ring resonator system. Chaotic signals can be employed to generate data of logic codes to be transmitted along the fiber optic communication. Controlling of the chaotic signals can be implemented by the parameter of the system such as coupling coefficient, the ring's radius, coupling loss and input power. The central wavelength of the input Gaussian laser pulse has been selected to λ_0=1550 nm where the nonlinear refractive index of the medium is $n_2=1.4\times10^{-13}$ m^2 W^{-1}. Therefore the data of logic codes generated by the single ring resonator system can be converted to transmitting secured codes where the decoding process of the transmitted codes can be obtained at the end of the transmission link. Here generation of logic code of "1010101010110101010111010111101011010101010101110101" is performed, encoded and decoded over 50 km fiber optics. Thus secured transmitting of signals can be obtained along the long distance fiber communication.

KEYWORD: *Single ring resonator; chaotic signals; encoding-decoding method; Fiber optics.*

I. INTRODUCTION

Chaotic signals [1] have some properties such as broadband [2], orthogonality [3] and complexity aspects, which prompt researches in the areas of nonlinear science [4-5], communication technology [6-7] and signal processing [8-9]. The concern in chaotic communications [10] was due to the foreseen good properties of the chaotic signals in the fields of security systems [11-12] or broadband multiple access systems [13-14]. The possibility of employing chaotic signals to carry information [15-16] was first studied in 1993. Encoding [17] is the process of adding the correct transitions to the message signal [18] in relation to the data [19] that is to be sent over the communication system [20]. Fiber optic sensors [21] and micro structured fibers [22] hold great promise for integration of multiple sensing channels [23-24]. Nonlinear behavior of light [25] inside a microring resonator [26] takes place when a strong pulse of light [27] is inserted into the ring system [28]. Chaotic controls [29-30] have been used in a great number of optical, engineering [31] and biological designed systems [32-33].

Encoding is used in binary search algorithms [34-35] to determine where the collided bit is. A method of encoding data into a chain reaction code includes generating a set of input symbols from input data [36]. Grover has provided fundamental information-theoretic bounds on the required circuit wiring complexity and power consumption for encoding and decoding of error-correcting codes [37]. In encoding method [38-39], the negative edge of signal means data-1, positive edge of signal means data-0. By decoding method [40], signals will not be changed, if a collision occurs. So, the reader can easily find the signals which are not changed for identifying the collision [41]. That is, the reader can determine easily where the collision bits are. In this work, generation of chaotic signals in a single ring resonator is presented. Thus the single ring resonator system [42-43] can be used to generate demand logic codes [44] where the technique of encoding and decoding of transmitting information [45] via optical logic signals can be obtained. Transmitting of signals can be secured [46] throughout the propagation along optical fiber communication [47] in which original and initial signals are recovered using the encoding-decoding technique [48]. This research is supported by the Institute of Advanced Photonics Science, Nanotechnology Research Alliance, Universiti Teknologi Malaysia (UTM).

II. Theoretical Background

Single ring resonator consists of a single coupler and a microring resonator [49-50]. Schematic of the single ring resonator is illustrated in Fig.1

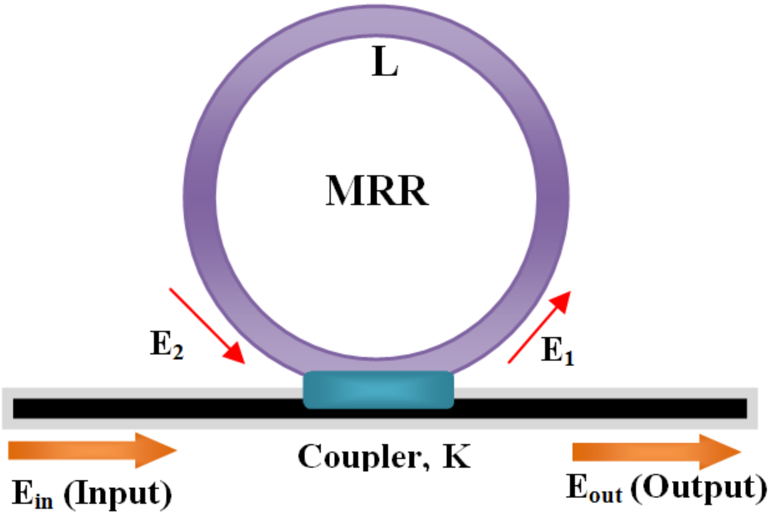

Fig. 1: Single microring resonator

Input light of a Gaussian laser beam is introduced into the system [51]. The fiber has a nonlinear refractive index of n_2 and a linear absorption coefficient of α [52-53]. The intensity coupling coefficient of the fiber coupler is κ, where γ is a coupling loss of the field amplitude [54]. The fiber ring has a resonant condition for the specific wavelength in the linear case [55]. Here the fiber coupler is considered as a point device and is reciprocal [56]. The refractive index (n) of light within the medium is given by [57]

$$n = n_0 + n_2 I = n_0 + \left(\frac{n_2}{A_{eff}}\right)P, \quad (1)$$

where n_0 and n_2 are the linear and nonlinear refractive indexes, respectively [58]. I and P are the optical intensity and optical power, respectively [59]. The effective mode core area of the device is shown by A_{eff} [60]. The effective mode core areas range from 0.50 to 0.10 μm^2 [61]. The relation between the electric fields E_1 and E_2, can be expressed using the nonlinear form as:

$$E_2 = E_1 x \exp\{-j(\phi_0 + \phi_{NL})\}, \quad (2)$$

where $\phi_0 = kLn_0$ and $\phi_{NL} = kLn_2|E_1|^2$ are expressed as linear and nonlinear phase shift [62], $k = 2\pi/\lambda$ is a wave number and L is the circumference of the ring resonator. $x = \exp(-\alpha L/2)$ represents a round trip loss for the input pulse propagating inside the microring resonator [63]. The resonant output is formed, thus, the normalized output of the light field is the ratio between the output and input fields E_{out} (t) and E_{in} (t) in each round-trip, which can be expressed as [64]

$$|E_{out}(t)|^2 = |E_{in}(t)|^2 \times (1-\gamma) - \frac{(1 - x^2 + 2\gamma x^2 - \gamma - \gamma^2 x^2)\kappa}{(1 - x\sqrt{1-\gamma}\sqrt{1-\kappa})^2 + 4x\sqrt{1-\gamma}\sqrt{1-\kappa}\sin^2(\frac{\phi}{2})} \quad (3)$$

Here the particular case of a Fabry-Perot cavity, which has an input and an output mirror with a field reflectivity, (1-κ), and a fully reflecting mirror is presented [65]. L and α are a waveguide length and linear absorption coefficient, respectively. The simulated results are based on the solution of the nonlinear Schrödinger Equation (NLSE) for the case of ring resonators using MATLAB programming. The simulation results of the logic codes are obtained by using the equation (3) respect to 20000 round-trip of the propagating input Gaussian laser pulse within the single ring resonator. Therefore the logic codes are inserted into the encoding and decoding system where the simulated results of the system are obtained using the optical communication system design or optisystem software. We use the optisystem software to design the fiber optic communications system and the simulation results are presented, which can enhance the understanding of each component of the fiber optic communications system, where its function provides guidance in the real experimental design.

III. SIMULATION RESULTS AND DISCUSSION

The output signal of single ring resonator for 20000 round trips of the input signals is simulated. Signals of logic code generated from the single ring resonator can be seen from Figure 2, where the optical power is fixed to 2 W at central wavelength of λ_0=1550 nm and the parameters of the system are selected to n_0=3.34, n_2=1.4×10^{-13} m^2 W^{-1}, A$_{eff}$=0.25 µm^2, α=0.5 dB mm^{-1}, γ=0.1, R=10 µm and κ=0.0225. Figure 2(a) shows the output chaotic signals versus the ring round-trip, where the figure 2(b) shows the output signals regarding to the input power. The analog and logic codes of the "0" and "1" can be generated and seen from figures 2(c) and 2(d). In application, in this research the logic codes of "1010101010110101010111010111010110101010101010110101" within the range of 9050-9100 round-trip could be generated using chaotic signals from the single ring resonator.

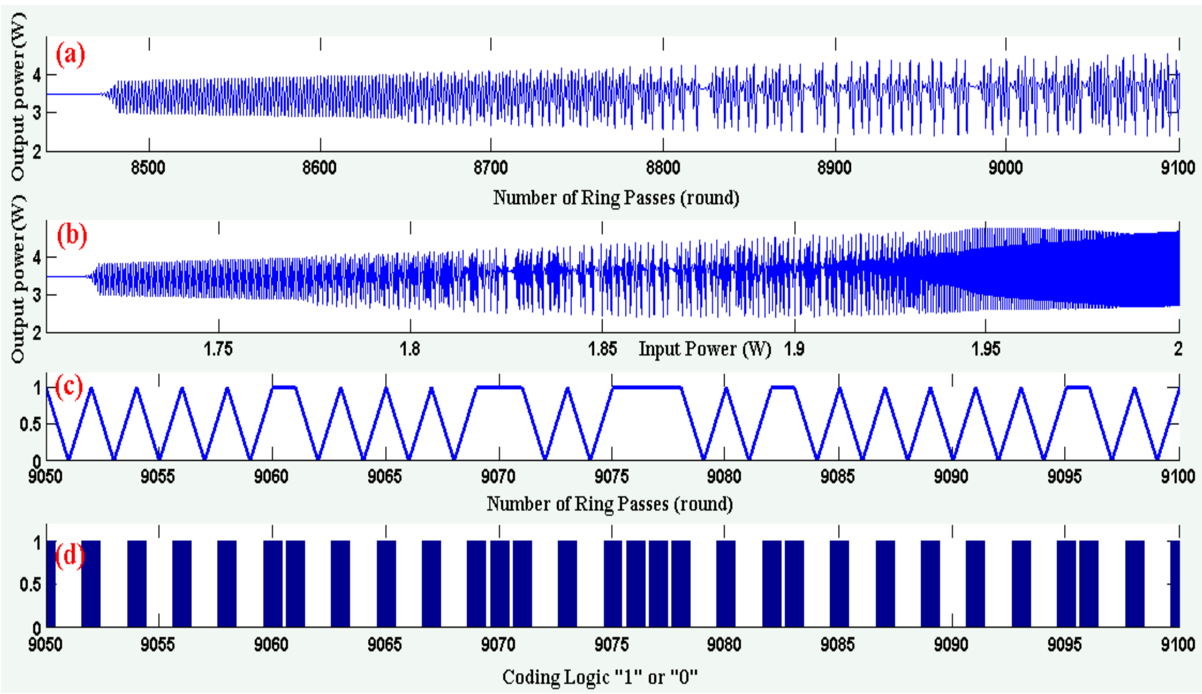

Fig.2: Simulation results of chaotic signals, where (a): output power versus round-trip, (b): output power versus input power, (c): Analog Codes, (d): Logic Codes of "0" and "1".

Thus, ring resonators are suitable to generate chaotic signals, while the logic codes (digital codes) are performed by the encrypted data. The logic codes can be transmitted over long distance communication using an encoding-decoding system. Transmitted signals can be received by the users and decoded at the end of the transmission link. The synchronously decryption of the encrypted data is processed before the chaotic codes being intercepted by the specific users via the design chaotic filters, finally, the required signals can be retrieved [23]. The system of encoding and decoding of the transmitting signals is shown in figure 3.

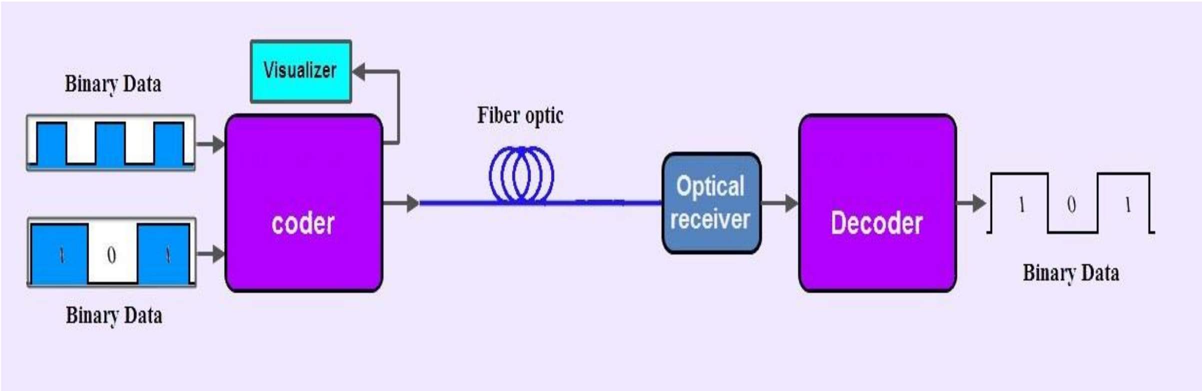

Fig. 3: system of encoding and decoding

Generated logic codes can be input into the encoding-decoding system. Therefore, signals in the form of encoded pulses propagate inside the optical fiber communication securely and finally can be received, detected and decoded by the users. Figure 4 shows the forms of transmitting signals in the communication system.

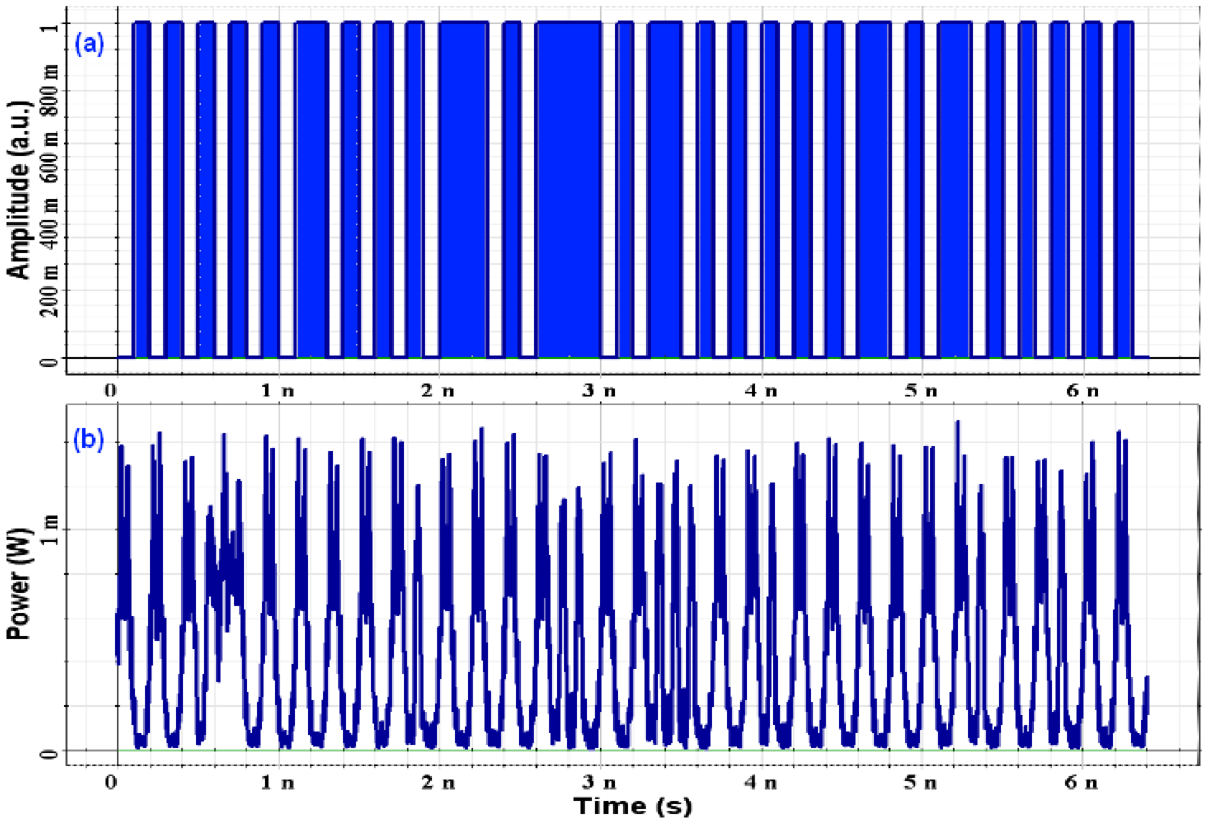

Fig. 4: Generation of transmitting signals where (a): Signals of logic codes, (b): Encoded signals

The length of the optical fiber has been selected to L=50 km, where transmitted of encoded signals can be received and detected at the end of the transmission link. Figure 5 shows the eye diagram of the detected signals and the decoded result. From figure 5 (b) the original input logic codes can be retrieved which means information or data can be transmitted securely and finally be recovered with less error of the detector.

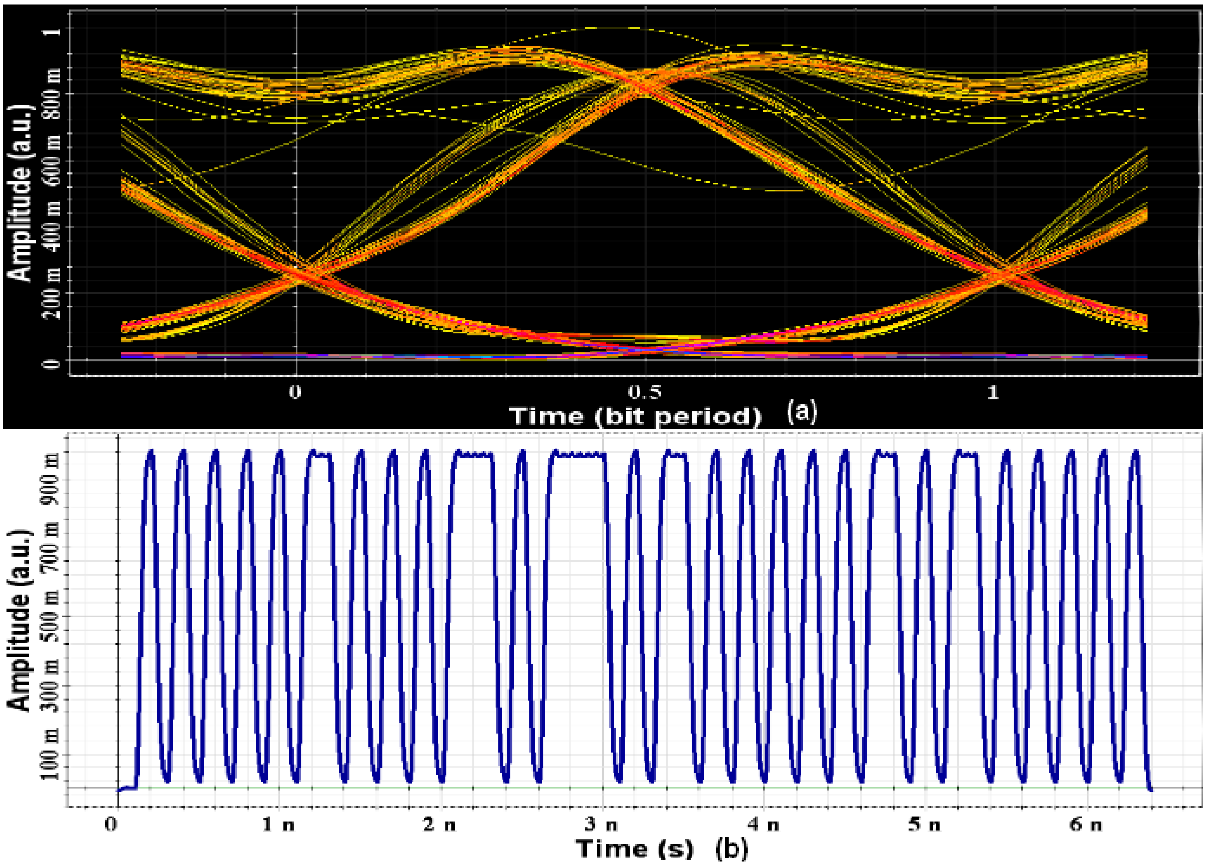

Fig. 5: Detection of transmitting signals where (a): Eye diagram of the transmitted signals, (b): decoded signals over 50 km fiber optic communications.

Thus, signals of chaotic can be used to generate variable codes. In this concept, we assume that the decoding of the transmitted signals can be performed by using the proposed arrangement. Optical codes via chaotic signals can be connected into a fiber network communication system, therefore, transmission of data along fiber optic is performed using a system of encoding-decoding. The security scheme of the transmission can be obtained where the high capacity of transmission requires highly optical signals such as chaotic signals which is employed.

IV. FUTURE WORK

There are works to be considered in future research. The first thing is to further fabrication on the single ring resonator. Another concern is the the timing testing which is used to determine the maximum optimum bit rate, where the high speed of transmission is recommended. For the use of Euclidean distance, received signal will be processed by the receiver which combines both demodulation and decoding in a single stage. Higher code rate can be obtained by generating of higher chaotic signals which requires design efficient implementation of encoding / decoding logic codes.

V. CONCLUSION

In conclusion, we have presented nonlinear effects of a single ring resonator known as optical chaos. Gaussian laser pulse with central wavelength of 1.55 µm is inserted into the system generating high capacity of chaotic signals. The optical input power was fixed to 2 W, where the parameters of the system have been selected to n_0=3.34, n_2=1.4×10^{-13} m^2 W^{-1}, A_{eff}=0.25 µm^2, α=0.5 dB mm^{-1}, γ=0.1, R=10 µm and κ=0.0225. Transmission of signals can be implemented via an encoding-decoding method where the encoded signals of the logic codes can be obtained and secured during transmission along long distance fiber optic communication. Here the logic codes of

"1010101010110101010111010111101011010101010110101" could be generated from chaotic signals using a ring resonator system. The decoding of signals can be obtained at the end of the transmission link. Here the length of the transmission link has been selected for 50 km where clear and decoded signals were achieved by the users thus providing secured and high capacity of optical soliton communication.

ACKNOWLEDGEMENTS

I. S. Amiri would like to thank the Institute of Advanced Photonics Science, Nanotechnology Research Alliance, Universiti Teknologi Malaysia (UTM).

REFERENCE

[1] M. Kouhnavard, A. Afroozeh, I. S. Amiri, M. A. Jalil, J. Ali and P. P. Yupapin, "New system of Chaotic Signal Generation Using MRR". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[2] P. Yupapin, M. Jalil, I. S. Amiri, I. Naim and J. Ali, "New Communication Bands Generated by Using a Soliton Pulse within a Resonator System", Circuits and Systems, **1.** (2010)

[3] I. S. Amiri, M. Nikmaram, A. Shahidinejad and J. Ali, "CRYPTOGRAPHY SCHEME OF AN OPTICAL SWITCHING SYSTEM USING PICO/FEMTO SECOND SOLITON PULSE", International Journal of Advances in Engineering & Technology (IJAET), **5.** 1. 176-184, (2012)

[4] M. kouhnavard, A. Afroozeh, M. A. Jalil, I. S. Amiri, J. Ali and P. P. Yupapin, "Optical Bistability In a FORR". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[5] C. Tanaram, C. Teeka, R. Jomtarak, P. Yupapin, M. Jalil, I. S. Amiri and J. Ali, "ASK-to-PSK Generation based on Nonlinear Microring Resonators Coupled to One MZI Arm", Procedia Engineering, **8.** 432-435, (2011)

[6] I. S. Amiri, S. Babakhani, G. Vahedi, J. Ali and P. Yupapin, "Dark-Bright Solitons Conversion System for Secured and Long Distance Optical Communication", IOSR Journal of Applied Physics (IOSR-JAP), **2.** 1. 43-48, (2012)

[7] A. A. Shojaei and I. S. Amiri, "DSA for Secured Optical Communication". In Proceedings of the The International Conference for Nanomaterials Synthesis and Characterization (INSC) Conference (Kuala Lumpur, Malaysia, 4 –5th July 2011).

[8] M. A. Jalil, I. S. Amiri, J. Ali and P. P. Yupapin, "Dark-Bright Solitons Conversion System via an Add/Drop Filter for Signal Security Application". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[9] I. S. Amiri, M. A. Jalil, A. Afroozeh, M. Kouhnavard , J. Ali and P. P. Yupapin, "Controlling Center Wavelength and Free Spectrum Range by MRR Radii". In Proceedings of the Faculty of Science Postgraduate Conference (FSPGC) (Universiti Teknologi Malaysia, 5-7 OCTOBER 2010).

[10] A. Afroozeh, M. Bahadoran, I. S. Amiri, A. R. Samavati, J. Ali and P. P. Yupapin, "Fast Light Generation Using Microring Resonators for Optical Communication". In Proceedings of the National Science Postgraduate Conference NSPC (Universiti Teknologi Malaysia, 15-17 November 2011).

[11] I. S. Amiri, A. Nikoukar and J. Ali, "Secured Binary Codes Generation for Computer Network Communication". In Proceedings of the Network Technologies & Communications (NTC) Conference (Singapore, 2010-2011).

[12] I. S. Amiri, G. Vahedi, A. Shojaei, A. Nikoukar, J. Ali and P. P. Yupapin, "Secured Transportation of Quantum Codes Using Integrated PANDA-Add/drop and TDMA Systems", International Journal of Engineering Research & Technology (IJERT), **1.** 5. (2012)

[13] A. A. Shojaei and I. S. Amiri, "Soliton for Radio wave generation". In Proceedings of the The International Conference for Nanomaterials Synthesis and Characterization (INSC) Conference (Kuala Lumpur, Malaysia, 4 –5th July 2011).

[14] M. A. Jalil, I. S. Amiri, M. Kouhnavard, A. Afroozeh, J. Ali and P. P. Yupapin, "Finesse Improvements of Light Pulses within MRR System". In Proceedings of the Faculty of Science Postgraduate Conference (FSPGC) (Universiti Teknologi Malaysia, 5-7 October 2010).

[15] M. A. Jalil, I. S. Amiri, C. Teeka, J. Ali and P. Yupapin, "All-optical Logic XOR/XNOR Gate Operation using Microring and Nanoring Resonators", Global Journal of Physics Express, **1.** 1. 15-22, (2011)

[16] A. Afroozeh, M. Kouhnavard, I. S. Amiri, M. A. Jalil, J. Ali and P. P. Yupapin, "Effect of Center Wavelength on MRR Performance". In Proceedings of the Faculty of Science Postgraduate Conference (FSPGC) (Universiti Teknologi Malaysia, 5-7 OCTOBER 2010).

[17] I. S. Amiri, A. Shahidinejad, A. Nikoukar, M. Ranjbar, J. Ali and P. P. Yupapin, "Digital Binary Codes Transmission via TDMA Networks Communication System Using Dark and Bright Optical Soliton", GSTF Journal on Computing (joc), **2.** 1. (2012)

[18] I. S. Amiri, A. Afroozeh, J. Ali and P. Yupapin, "Generation Of Quantum Codes Using Up And Down Link Optical Solition", Jurnal Teknologi, **55.** 97–106, (2012)

[19] I. S. Amiri, A. Nikoukar, A. Shahidinejad, M. Ranjbar, J. Ali and P. P. Yupapin, "Generation of Quantum Photon Information Using Extremely Narrow Optical Tweezers for Computer Network Communication", GSTF Journal on Computing (joc), **2.** 1. (2012)

[20] A. Afroozeh, I. S. Amiri, M. Bahadoran, J. Ali and P. Yupapin, "Simulation Of Soliton Amplification In Micro Ring Resonator For Optical Communication", Jurnal Teknologi, **55.** 271–277, (2012)

[21] W. Ecke, K. Chen and J. Leng, "Fiber Optic Sensors", Journal of Sensors, **2012.** (2012)

[22] E. Chillcce, R. Narro-García, J. Menezes, E. Rodriguez, D. Marconi, H. Fragnito and L. Barbosa, "Er 3+-doped micro-structured tellurite fiber: laser generation and optical gain", International Society for Optics and Photonics, City, 2012.

[23] S. Daud, M. A. Jalil, I. S. Amiri, Saktioto, R. A. Rahman, J. Ali and P. P. Yupapin, "FBG Simulation and Experimental Temperature Measurement". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[24] S. Daud, M. A. Jalil, I. S. Amiri, Saktioto, R. A. Rahman, J. Ali and P. P. Yupapin, "FBG Sensing System for Outdoor Temperature Measurement". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[25] C. Teeka, S. Songmuang, R. Jomtarak, P. Yupapin, M. Jalil, I. S. Amiri and J. Ali, "ASK-to-PSK Generation based on Nonlinear Microring Resonators Coupled to One MZI Arm", AIP Conference Proceedings, City, 2011.

[26] F. K. Mohamad, N. J. Ridha, I. S. Amiri, Saktioto, J. Ali and P. P. Yupapin, "Effect of Center Wavelength on MRR Performance". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[27] M. Imran, R. A. Rahman and I. S. Amiri, "Fabrication of Diffractive Optical Element using Direct Writing CO2 Laser Irradiation". In Proceedings of the Faculty of Science Postgraduate Conference (FSPGC) (Universiti Teknologi Malaysia, 5-7 October 2010).

[28] M. Kouhnavard, A. Afroozeh, M. A. Jalil, I. S. Amiri, J. Ali and P. P. Yupapin, "Soliton Signals and the Effect of Coupling Coefficient in MRR Systems". In Proceedings of the Faculty of Science Postgraduate Conference (FSPGC) (Universiti Teknologi Malaysia, 5-7 October, 2010).

[29] N. J. Ridha, F. K. Mohamad, I. S. Amiri, Saktioto, J. Ali and P. P. Yupapin, "Controlling Center Wavelength and Free Spectrum Range by MRR Radii ". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[30] A. Shahidinejad, A. Nikoukar, I. S. Amiri, M. Ranjbar, A. Shojaei, J. Ali and P. Yupapin, "Network system engineering by controlling the chaotic signals using silicon micro ring resonator", IEEE Explore, City, 2012.

[31] I. S. Amiri, G. Vahedi, A. Nikoukar, A. Shojaei, J. Ali and P. Yupapin, "Decimal Convertor Application for Optical Wireless Communication by Generating of Dark and Bright Signals of soliton", International Journal of Engineering Research & Technology (IJERT), **1.** 5. (2012)

[32] A. Afroozeh, I. S. Amiri, A. Samavati, J. Ali and P. Yupapin, "THz frequency generation using MRRs for THz imaging", IEEE Explore, City, 2012.

[33] M. Hamdi, T. Saktioto, I. S. Amiri and A. J., "Transition of Diatomic Molecular Oscillator Process in THz Region". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[34] I. S. Amiri, A. Shahidinejad, A. Nikoukar, J. Ali and P. Yupapin, "A Study oF Dynamic Optical Tweezers Generation For Communication Networks", International Journal of Advances in Engineering & Technology (IJAET), **4.** 2. 38-45 (2012)

[35] I. S. Amiri, A. Nikoukar and J. Ali, "Quantum Information Generation Using Optical Potential Well". In Proceedings of the Network Technologies & Communications (NTC) Conference (Singapore, 2010-2011).

[36] A. M. Shokrollahi and M. G. Luby, "Systematic encoding and decoding of chain reaction codes", EP Patent 2,357,731, City, 2011.

[37] P. Grover, A. Goldsmith and A. Sahai, "Fundamental limits on the power consumption of encoding and decoding", IEEE, City, 2012.

[38] I. S. Amiri, M. H. Khanmirzaei, M. Kouhnavard, P. P. Yupapin and J. Ali Quantum Entanglement using Multi Dark Soliton Correlation for Multivariable Quantum Router, Nova Publisher, New York, 2012.

[39] M. Kouhnavard, I. S. Amiri, M. Jalil, A. Afroozeh, J. Ali and P. P. Yupapin, "QKD via a quantum wavelength router using spatial soliton", IEEE Explore, City, 2010.

[40] S. Sekiguchi, Y. Yamada and K. Asai, "Digital signal coding method and apparatus, digital signal decoding apparatus, digital signal arithmetic coding method and digital signal arithmetic decoding method", Google Patents, City, 2012.

[41] I. S. Amiri, A. Afroozeh, M. Bahadoran, J. Ali and P. Yupapin, "Molecular Transporter System For Qubits Generation", Jurnal Teknologi, **55.** 155–165, (2012)

[42] A. Nikoukar, I. S. Amiri, A. Shahidinejad, A. Shojaei, J. Ali and P. Yupapin, "MRR quantum dense coding for optical wireless communication system using decimal convertor", IEEE Explore, City, 2012.

[43] N. J. Ridha, F. K. Mohamad, I. S. Amiri, Saktioto, J. Ali and P. P. Yupapin, "Soliton Signals and The Effect of Coupling Coefficient in MRR Systems". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[44] I. S. Amiri, A. Nikoukar, A. Shahidinejad, J. Ali and P. Yupapin, "Generation of discrete frequency and wavelength for secured computer networks system using integrated ring resonators", IEEE Explore, City, 2012.

[45] I. S. Amiri, M. Ranjbar, A. Nikoukar, A. Shahidinejad, J. Ali and P. Yupapin, "Multi optical Soliton generated by PANDA ring resonator for secure network communication", IEEE Explore, City, 2012.

[46] I. S. Amiri, A. Afroozeh, I. Nawi, M. Jalil, A. Mohamad, J. Ali and P. Yupapin, "Dark Soliton Array for Communication Security", Procedia Engineering, **8.** 417-422, (2011)

[47] I. S. Amiri, A. Nikoukar, G. Vahedi, A. Shojaei, J. Ali and P. Yupapin, "Frequency-Wavelength Trapping by Integrated Ring Resonators For Secured Network and Communication Systems", International Journal of Engineering Research & Technology (IJERT), **1.** 5. (2012)

[48] S. Dutta and S. Mukhopadhyay, "A new approach of parallel data transmission through optical waveguide with SOA based frequency encoding/decoding technique", Optik-International Journal for Light and Electron Optics, **123.** 3. 212-216, (2012)

[49] I. S. Amiri, M. A. Jalil, F. K. Mohamad, N. J. Ridha, J. Ali and P. P. Yupapin, "Storage of Optical Soliton Wavelengths Using NMRR". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[50] A. Afroozeh, I. S. Amiri, M. Kouhnavard, M. Bahadoran, M. A. Jalil, J. Ali and P. P. Yupapin, "Dark and Bright Soliton trapping using NMRR". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[51] A. Afroozeh, I. S. Amiri, M. Kouhnavard, M. Bahadoran, M. A. Jalil, J. Ali and P. P. Yupapin, "Optical Memory Time using Multi Bright Soliton". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[52] I. S. Amiri, M. A. Jalil, F. K. Mohamad, N. J. Ridha, J. Ali and P. P. Yupapin, "Storage of Atom/Molecules/Photon using Optical Potential Wells". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[53] F. K. Mohamad, N. J. Ridha, I. S. Amiri, Saktioto, J. Ali and P. P. Yupapin, "Finesse Improvements of Light Pulses within MRR System". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[54] A. Afroozeh, I. S. Amiri, J. Ali and P. Yupapin, "Determination Of FWHM For Soliton Trapping", Jurnal Teknologi, **55.** 77–83, (2012)

[55] I. S. Amiri, A. Afroozeh, M. Bahadoran, J. Ali and P. P. Yupapin, "Up and Down Link of Soliton for Network Communication". In Proceedings of the National Science Postgraduate Conference, NSPC (Malaysia, 15-17 November 2011).

[56] N. Suwanpayak, S. Songmuang, M. Jalil, I. S. Amiri, I. Naim, J. Ali and P. Yupapin, "Tunable and storage potential wells using microring resonator system for bio-cell trapping and delivery", IEEE Explore, City, 2010.

[57] A. Afroozeh, I. S. Amiri, M. Kouhnavard, M. Jalil, J. Ali and P. Yupapin, "Optical dark and bright soliton generation and amplification", IEEE Explore, City, 2010.

[58] M. A. Jalil, I. S. Amiri, J. Ali and P. P. Yupapin, "Fast and slow lights via an add/drop device". In Proceedings of the The International Conference on Experimental Mechanics (ICEM) (Kuala Lumpur, Malaysia, 29 November-1 December 2010).

[59] I. S. Amiri, J. Ali and P. Yupapin, "Enhancement of FSR and Finesse Using Add/Drop Filter and PANDA Ring Resonator Systems", International Journal of Modern Physics B, **26.** 04. (2012)

[60] M. Bahadoran, I. S. Amiri, A. Afroozeh, J. Ali and P. P. Yupapin, "Analytical Vernier Effect for Silicon Panda Ring Resonator". In Proceedings of the National Science Postgraduate Conference, NSPC (Universiti Teknologi Malaysia, 15-17 November 2011).

[61] I. S. Amiri, A. Afroozeh and M. Bahadoran, "Simulation and Analysis of Multisoliton Generation Using a PANDA Ring Resonator System", Chinese Physics Letters, **28.** 104205, (2011)
[62] I. S. Amiri, K. Raman, A. Afroozeh, M. Jalil, I. Nawi, J. Ali and P. Yupapin, "Generation of DSA for Security Application", Procedia Engineering, **8.** 360-365, (2011)
[63] I. S. Amiri, A. Nikoukar, J. Ali and P. Yupapin, "Ultra-Short of Pico and Femtosecond Soliton Laser Pulse Using Microring Resonator for Cancer Cells Treatment", Quantum Matter, **1.** 2. 159-165, (2012)
[64] A. Afroozeh, I. S. Amiri, M. A. Jalil, M. Kouhnavard, J. Ali and P. P. Yupapin, "Multi Soliton Generation for Enhance Optical Communication", Applied Mechanics and Materials, **83.** 136-140, (2011)
[65] A. Afroozeh, M. Bahadoran, I. S. Amiri, A. R. Samavati, J. Ali and P. P. Yupapin, "Fast Light Generation Using GaAlAs/GaAs Waveguide", Jurnal Teknologi, **57.** 7, (2012)

BIOGRAPHY OF AUTHORS

D. Gifany received his B. Eng from Malek Ashtar University of Technology, Iran in 2008 and M. Eng. in Embedded System from Multimedia Universiti Malaysia, in 2012. Currently he is working as Embedded Software Developer in Smart Surface SdnBhd. His research interests are in the field of image processing, signal processing, communication security, operating system.

I. S. Amiri received his B. Sc (Hons, Applied Physics) from Public University of Oroumiyeh, Iran in 2001 and a gold medalist M. Sc. in Applied Physics from Universiti Teknologi Malaysia, in 2009. He is currently pursuing his Ph.D. in Nano Photonics at the Faculty of Science, Institute of Advanced Photonics Science, Nanotechnology Research Alliance, (UTM), Malaysia. He has authored/co-authored more than 75 technical papers published in journals/conferences and a book chapter. His research interests are in the field of optical soliton communication, signal processing, communication security, quantum cryptography, quantum chaos, optical tweezers and hybrid computing system.

Masoud Ranjbar received his B. Sc (Electronics) from Azad University of bojnourd, Iran in 2009. He is currently pursuing his Master in Electronics and Telecommunication at the Faculty of Electrical Engineering, (UTM), Malaysia. His research interests are in the field of optical soliton communication, communication security and coding. He has worked as an instrumentation engineer in Khorasan Petrochemical Company from 2007 to 2010.

J. Ali received his Ph.D. in plasma physics from Universiti Teknologi Malaysia (UTM) in 1990. At present, he is a professor of photonics at the Institute of Advanced Photonics Science, Nanotech Research Alliance and the Physics Department of UTM. He has authored/co-authored more than 200 technical papers published in international journal, three books and a number of book chapters. His areas of interests are in FBGs, optical solitons, fiber couplers, and nanowaveguides. He is currently the Head of Nanophotonics research group, Nanotech Research Alliance, UTM. Dr. Jalil Ali is a member of OSA, SPIE, and the Malaysian Institute of Physics.