

RESUME

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Educations:

- PhD, Department of Electronics Engineering, Indian School of Mines, Dhanbad, Jharkhand, India. February, 2023.
PhD Thesis Title: “**Design and Analysis of Some Photonic Crystal Based Interconnecting and Logic Devices for PIC.**”
(Supervisor: Dr. Mrinal Sen, Associate Professor, Dept. of ECE, IIT (ISM) Dhanbad).
- Masters in Engineering (Electronics & Telecommunication Engineering) (2010), Jadavpur University, Kolkata, West Bengal, India. (1st class).
ME Thesis Title: “**A Study on Some Variation of the Fuzzy C-means Clustering Algorithm.**”
(Advisor: Dr. Ananda Shankar Chowdhury, Department of Electronics and Communication Engineering, Jadavpur University, Jadavpur, West Bengal, India).
- Bachelor in Engineering (2002) in Electronics and Communication Engineering, Kalpataru Institute of Technology, Bangalore University (1st class).
BE Thesis Title: “**Design and Implementation of #Lock and #Plock Pin and Signals of I486 Microprocessor Used in Communication Switch.**”
(Advisor: Dr. Uday Narayan Sinha, Senior Scientist, National Aerospace Laboratories, Bangalore).
- 10+2nd Standard (1996), WBCHSE, West Bengal, India, (1st class).
- 10th Standard (1994), WBBSE, West Bengal, India, (1st class).

Abstract of PhD Thesis:

The emerging need for high-speed data processing has made applications of all-optical signal processing circuits and logic devices inevitable in future generation computing platforms. Silicon-based Photonic Integrated Circuit (PIC) is a viable platform to realize such devices, as it provides high speed, consumes low power, and is compatible with the existing CMOS foundry. Photonic Crystal (PhC) is a promising platform for realizing silicon-based PICs, as it offers several unique properties to mould the light, like – photonic band gap (PBG), self-collimation, and slow-light propagation, and comparatively easy manipulation of light propagation than other platforms. However, a review of PhC-based devices for PICs shows that there is a need for developing efficient designs of some interconnecting devices, like – isolator and waveguide bends, and logic devices, like – decoder and adder, based on linear optical phenomena. So has been taken up as the research objective of the thesis. Five contributions, as follows, have been made in this thesis to fulfil these objectives.

At first, an all-optical isolator based on a 2D silicon rods-in-air square lattice PhC has been proposed that works on the light beam interference phenomenon. The design utilizes a bias signal to interfere constructively with the forward propagating beam but destructively with the reverse. The device can offer a contrast ratio of 10 dB and a bandwidth of ~ 6.2 THz, at around the wavelength of $1.55 \mu\text{m}$. A 3D equivalent structure of the device has also been designed, whose performances almost corroborate with its 2D counterpart. However, fabrication of the structure is quite challenging due to the

aspect ratio of the rods. Hence, a more practically feasible holes-in-slab PhC platform is chosen to design the remaining devices.

Nevertheless, waveguide bend is an inevitable part of almost all such designs. However, a waveguide bend in holes-in-slab usually encounters a high loss. Therefore, optimization strategies of different bending geometries in a triangular-lattice line-defect holes-in-slab photonic crystal (PhC) structure have been developed next. The development shows that high transmittance through 30° , 60° , or 120° bends can be attained by merely optimizing the radius of a single hole at the corner region of the bend. On the other hand, two corner holes in a 90° bend of the triangular-lattice PhC need to be optimized to attain a high transmittance. At corresponding optimization, transmittance losses for the 30° , 60° , 90° , and 120° bends are obtained as 0.07 dB, 0.11 dB, 0.45 dB, and 0.22 dB, respectively. Further investigations have also been performed to – evaluate the criticality in choosing the optimized holes' radii, to provide design guidelines for an arbitrary wavelength of operation, and to evaluate the fabrication tolerance of the device. These investigations exhibit a large span of suitable radii for these optimized holes and tolerance of up to 20 nm random structural imperfection of the designs.

Further, a new design of an all-optical isolator based on a 2D square lattice holes-in-slab silicon-PhC structure is proposed using a hybrid PhC interface formed by two PhC sections of the same lattice constant but of different lattice configuration. A junction asymmetry, formed by modulating some holes' radii, directs the light from the input to the output port but from output to a drop port. The forward and the reverse transmittance of this $416\ \mu\text{m}^2$ footprint device are found to be -1.43 dB and -10 dB, respectively, at the wavelength of $1.55\ \mu\text{m}$, resulting in a contrast ratio of 8.57 dB.

A design of a holes-in-slab silicon-PhC-based all-optical 1-to-2 line decoder is proposed next. In order to alleviate the wavelength dependency of beam interference, on which the device is modelled, a PhC MMI-based π -phase-shifter is designed. This phase-shifter is used further in the design of the 1-to-2 line optical decoder. FDTD simulations for the possible logic states of the decoder confirm the targeted outcomes. The transmittance analyses have also confirmed that the device is able to operate up to a bit rate of 1.44 THz, considering $\geq 80\%$ transmission at logic 1 and $\leq 10\%$ at logic 0. Finally, a successful decoding operation is obtained under pulsating inputs, having a pulse width of 1 ps, corresponding to a bit rate of 1 THz.

Thereafter, an all-optical half-adder based on holes-in-slab silicon PhC is proposed. A rhombus-shaped structure made of four W1 waveguides along with the PhC MMI-based π -phase-shifter is used in this design. FDTD simulations depict that for the $\{0,1\}$, $\{1,0\}$, and $\{1,1\}$ logic combinations the SUM port exhibit 60%, 67%, and 1% transmittance, respectively; whereas, so for the CARRY port are 4%, 1%, and 90%. The simulation outcomes show a contrast ratio of 18 dB at the SUM port and 12.5 dB at the CARRY port.

Therefore, the thesis proposes three interconnecting devices and two logic devices based on the photonic crystal platform for application in PICs. These devices provide remarkable performance and, in some cases, new design strategies.

Work Experience:

- February, 2004 — February, 2008:

Lecturer in Department of ECE, Birbhum Institute of Engineering and Technology, Birbhum, West Bengal, India.

- March, 2010 — June, 2010:

Senior Lecturer in Department of ECE, Birbhum Institute of Engineering and Technology, Suri, West Bengal.

- July, 2010 — June, 2021:

Assistant Professor in Department of ECE, Birbhum Institute of Engineering and Technology, Suri, West Bengal.

- August, 2023 — till date:

Assistant Professor in Department of ECE, Haldia Institute of technology, Purba Medinipore, West Bengal.

Details of Administrative Activities:

- Carried on duty of Teacher-in-Charge, Dept. of ECE
- Carried on duty of hostel superintendent
- Member of College Disciplinary Committee
- Member of College Academic Committee

Details of professional training and research experience:

- Two weeks ISTE Main Workshop on “Basic Electronics” under the National Mission on Education through ICT (MHRD, Govt. of India). IIT Bombay, June 28th, 2011 to July 8th 2011.
- Two weeks ISTE Main Workshop on “Signals and Systems” under the National Mission on Education through ICT (MHRD, Govt. of India), IIT, Kharagpur, Jan 2nd ,2014 to Jan 12th ,2014.
- Short Term Course on Faculty Development Programme for Effective Teaching, Centre for Educational Technology, IIT Kharagpur, July 10, 2014 to July 12 2014.
- Short Term Training Program on Optical Fibre Communication, NITTTR, Kolkata, Oct. 12, 2015 to Oct. 16, 2015

Area of Interest:

- Basic Electronics, Analog Electronics, Digital Circuit, Analog Communication, Optical Communication, Photonic Integrated Circuit.

Personal Details:

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Publications:

Journals:

1. **K. Goswami**, H. Mondal, and M. Sen, “A review on all-optical logic adder: Heading towards next-generation processor,” *Optics Communications*, vol. 483, p. 126668, Mar. 2021, doi: <https://doi.org/10.1016/j.optcom.2020.126668>.
2. **K. Goswami**, H. Mondal, and M. Sen, “Optimized design of multiple bends for maximum power transfer in optical waveguide.” *Optik*, vol. 265, p. 169448, 2022, doi: 10.1016/j.ijleo.2022.169448.
3. **K. Goswami**, H. Mondal, M. Sen, and A. Sharma, “Design and Analysis of All-Optical Isolator Based on Linear Photonic Crystal.” *Brazilian Journal of Physics*, vol. 52, no. 3, 2022, doi: 10.1007/s13538-022-01086-8.
4. **K. Goswami**, H. Mondal, and M. Sen, “Design and analysis of passive and phase insensitive all-optical isolator in linear optical platform.” *Optics Communications*, vol. 529, p. 129071, 2023, doi: 10.1016/j.optcom.2022.129071.
5. **K. Goswami**, H.P. Mondal*, S. Dutta “Design and analysis of 1:2 line optical decoder based on linear optics”, *E-prime advances in electrical engineering, electronics and energy*, vol 5 June-2023, doi.org/10.1016/j.prime.2023.100190.
6. H. Mondal, M. Sen, C. Prakash, **K. Goswami**, and C. K. Sarma, “Impedance matching theory to design an all-optical AND gate.” *IET Optoelectronics*, vol. 12, no. 5, pp. 244–248, 2018, doi: 10.1049/iet-opt.2018.0020.
7. C. Prakash, M. Sen, H. Mondal, and **K. Goswami**, “Design and optimization of a TE-pass polarization filter based on a slotted photonic crystal waveguide.” *Journal of the Optical Society of America B*, vol. 35, no. 8, p. 1791, 2018, doi: 10.1364/josab.35.001791.

8. H. Mondal, M. Sen, and **K. Goswami**, "Design and analysis of all-optical 1-to-2 line decoder based on linear photonic crystal." *IET Optoelectronics*, vol. 13, no. 4, pp. 191–195, 2019, doi: 10.1049/iet-opt.2018.5099.
9. H. Mondal, M. Sen, and **K. Goswami**, "Design and analysis of a 09 Tb/s six-channel WDM filter based on photonic crystal waveguides." *Journal of the Optical Society of America B*, vol. 36, no. 11, p. 3181, 2019, doi: 10.1364/josab.36.003181.
10. A. Sharma, **K. Goswami**, H. Mondal, T. Datta, and M. Sen, "A review on photonic crystal based all-optical logic decoder: linear and nonlinear perspectives." *Optical and Quantum Electronics*, vol. 54, no. 2, 2022, doi: 10.1007/s11082-021-03473-y.
11. H. Mondal, **K. Goswami**, M. Sen, and W. R. Khan, "Design and analysis of all-optical logic NOR gate based on linear optics." *Optical and Quantum Electronics*, vol. 54, no. 5, 2022, doi: 10.1007/s11082-022-03624-9.
12. H. Mondal, **K. Goswami**, Nistha Dutta, Mukunda madhav Das, Swarna Bhatteya, Mrinal Sen, "Design and simulation of phase shifter based on multimode interference in photonic crystal waveguides", *The European Physical Journal D*, vol. 77, no. 10, Oct. 2023, doi: <https://doi.org/10.1140/epjd/s10053-023-00768-5>.
13. **K. Goswami**, H. Mondal, and M. K. Sen, "Design of 1-to-2-line all-optical decoder based on MMI phase shifter," *Optical and Quantum Electronics*, vol. 55, no. 9, Jun. 2023, doi: <https://doi.org/10.1007/s11082-023-05055-6>.
14. **K. Goswami**, H. Mondal, and M. K. Sen, "Design of all optical logic half adder based on holes-in-slab photonic crystal," *Optical and Quantum Electronics*, vol. 56, no. 2, Dec. 2023, doi: <https://doi.org/10.1007/s11082-023-05848-9>.

Conferences:

- 1 H.P. Mondal, **K. Goswami**, C. Prakash, and M. Sen, "An all-optical ultra-compact 4-channel wavelength de-multiplexer," *2018 3rd International Conference on Microwave and Photonics (ICMAP)*, Dhanbad, India, 2018, pp. 1–2, doi: 10.1109/ICMAP.2018.8354607.
- 2 C. Prakash, H.P. Mondal, **K. Goswami**, and M. Sen, "Investigation for the efficient interface of strip and PhC Slot waveguide," *2018 3rd International Conference on Microwave and Photonics (ICMAP)*, Dhanbad, India, 2018, pp. 1–2, doi: 10.1109/ICMAP.2018.8354622.
- 3 R. Arya, M. Sen, **K. Goswami**, and H.P. Mondal "Design of mobile robot and its optimum path planning", Emerging trends in computer technology (NCETCT-2012), R. C. Patel institute of technology, Shirpur, Maharashtra, 21-April,2012 Vol. 2 Issue 3, p63, Paper code- NCETET-040.

Book Chapters:

- 1 **K. Goswami**, H.P. Mondal, P. Das, and K. Thakuria, "Realization of ultra-compact all-optical logic AND gate based on photonic crystal waveguide", in book *Advances in Communication, devices and networking, LNEE Springer nature*, Singapore, ISBN-978-981-16-2911-2, vol.776, pp.61–68, (2021).
- 2 **K. Goswami**, H.P. Mondal, and M. Sen, "Optimized Design of 60 Degree Bend in Optical Waveguide for Efficient Power Transfer", in book *Advances in Communication, devices and networking, LNEE Springer nature*, Singapore, ISBN- 978-981-15-4931-1, vol. 662, pp. 47–52, (2020).
- 3 A. Sharma, H.P. Mondal, and **K. Goswami**, " Study of all-optical directional coupler based on holes in slab photonic crystal structure", in book *Advances in Communication, devices and networking, LNEE Springer nature*, Singapore, ISBN- 978-981-19-2004-2, vol.902, pp.15–23, (2023)

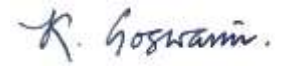
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I do hereby declare that the above information is true to the best of my knowledge and belief.

With regards,



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