

INFORMATION ON DOCTORAL THESIS

1. Full name:Nguyen Thi Hong Loan **2. Sex:**Female

3. Date of birth:08/05/1977**4. Place of birth:**Phu Tho

5. Admission decision number:654/QĐ-CTSV Dated September 5, 2016

6. Changes in academic process:

Adjust the thesis title to: “Research on optical label processing techniques in all-optical networks” according to Decision No. 1067/QĐ-DHCN dated June 6, 2024.

7. Official thesis title:Research on optical label processing techniques in all-optical networks

8. Major:Computer Networks and Data Communications**9. Code:**9480102

10. Supervisors:

PrincipalSupervisor: Associate Professor.Dr. Le Trung Thanh

Affiliation: International School, VietnamNational University, Hanoi

Co-Supervisor: Dr. Duong Le Minh

Affiliation: University of Engineering and Technology, Vietnam National University, Hanoi

11. Summary of the new findings of the thesis: The thesis has successfully achieved several novel results, contributing to the field:

The thesis has successfully achieved several novel results, contributing significantly to the field:

- *Design of All-Optical Structures for BPSK and QPSK Optical Labels:* The thesis presents two innovative all-optical structures for recognizing Binary Phase-Shift Keying (BPSK) and Quadrature Phase-Shift Keying (QPSK) optical labels in label-switched networks and optical header processing. These structures leverage the multi-mode interference effect on Silicon-on-Insulator (SOI) waveguides, compatible with current CMOS microfabrication technology. They offer low signal loss and the potential for integration on a single chip, facilitating easier fabrication compared to previous methods.

- *All-Optical XOR and NAND Logic Gate Structures:* The thesis introduces a design for all-optical XOR and NAND logic gate structures applicable in all-optical correlation units for optical label processing. The novel structure utilizes the plasmonic effect, achieving size reduction without the need for all-optical nonlinear effects.

- *Development of Optical Delay Lines and Header Extraction Units:* The thesis details the development of a structure for optical delay lines and an optical header extraction unit, applied in label-switched networks and optical header processing.

- *Photonic Neural Network for BPSK Optical Label Recognition*: The thesis describes the design of a photonic neural network structure for recognizing BPSK optical labels. This innovative photonic neural network structure employs optical components for the recognition of optical labels modulated with BPSK.

12. Practical applicability, if any:

- *Commercial Applications of Silicon Photonics Technology*: The primary commercial applications of silicon photonics technology include the implementation of short-range optical links for data centers and high-performance computing, as well as continuous transceivers for metropolitan and long-haul telecommunication systems.

- *Signal Processing in All-Optical Information Networks*: The utilization of integrated photonics technology for signal processing in all-optical information networks presents a robust solution for network systems and data centers. This approach enhances performance and reduces energy consumption while offering flexible, space-saving solutions for optical communication systems.

13. Further research directions, if any:

- *Design of Integrated Systems for Optical Image Transformation*: This includes the design of integrated systems for image transformation in the optical domain utilizing optical memories in smart camera systems and enabling real-time image data processing. Additionally, the design encompasses all-optical systems for AR/VR data processing.

- *Development of OONN Network Models for AI Applications*: This involves the development of OONN models tailored for real-time AI applications, with a particular focus on designing fully optical activation functions.

- *Enhancement of Graphene-Based Waveguide Structures*: This aims to improve the structure of graphene-based waveguides to increase data processing speed and learning rates, thereby addressing the demands of large-scale data analysis tasks.

14. Thesis-related publications:

1. Thi Hong Loan Nguyen, Duy Tien Le, Le Minh Duong and Trung Thanh Le (January 2024), "*All-optical BPSK label recognition in photonic switching networks using cascaded MMI structures on silicon-on-insulator platform*", Semiconductor Optoelectronics, Vol. 43, No.1, pp. 60-72 (Scopus Q4).
2. Thi Hong Loan Nguyen, Le Minh Duong, Yen Hai Pham, Duy Tien Le, and Trung Thanh Le (January 2024), "*All-optical QPSK label recognition in photonic switching networks using MMIs on the silicon-on-insulator (SOI) platform*", International Journal of Applied Engineering and Technology, Vol.6, No 1, Issue 1, pp. 77-83 (Scopus Q4).
3. Thi Thuy Bui, Duy Tien Le, Thi Hong Loan Nguyen, Trung Thanh Le (March 2023), "*On Chip Optical Neural Networks Based on MMI Microring Resonators for Image Classification*", Computer Optics, ISSN 0134-2452(print) ISSN 2412-6179 (online), 2023, Issue Vol. 47(4), DOI: 10.18287/2412-6179-CO-1211 (Q2 SCIE), pp. 588-595.
4. Thi Thuy Bui, Thi Hong Loan Nguyen, Duy Tien Le, Hai Yen Pham, Tien Thanh Do and Trung Thanh Le (June 2023), "*Coherent Optical Convolution Processor Based on MMI Structures for Deep Learning Applications*", The 2nd

International Conference on Computer Application Technology (CCAT 2023), Guiyang, China pp. 93-97, (Scopus).

5. Trung Thanh Le, Duy Tien Le, Anh Tuan Nguyen, Thi Hong Loan Nguyen and Duong The Do (2023). “*A Silicon-on-Insulator 4x4 Multimode Interference (MMI) Based Microring Structure for Highly Sensitive Hydrogen Detection*”. International Journal of Applied Engineering and Technology 5(3), pp.106-113. (Scopus Q4)
6. Trung Thanh Le, Duy Tien Le, The Duong Do, Thi Hong Loan Nguyen and Anh Tuan Nguyen (2023), “*A Silicon-On-Insulator Ring Resonator Assisted Mach Zehnder Interferometer Structure For Highly Sensitive Hydrogen Intensity Detection*”, Semiconductor Optoelectronics, Vol. 42 No. 2, pp.438-446 (Scopus Q4).
7. Do The Duong, Le Duy Tien, Nguyen Thi Hong Loan, Hoang Thanh Nhat, Le Trung Thanh (2023), “*Reconfigurable Generation of PAM-4 Signal Based on Fano Effect for Optical Interconnect Systems*”, VNU Journal of Science: Mathematics – Physics, Vol. 39, No. 3, pp.78-88.
8. Nguyen Thi Hong Loan, Le Duy Tien, Nguyen Anh Tuan, Le Minh Duong, and Le Trung Thanh (March 2022), “*All-Optical XNOR and XOR Logic Gates Based on Ultra-Compact Multimode Interference Couplers Using Silicon Hybrid Plasmonic Waveguides*”, in Communications, Signal Processing, and Systems, Singapore, Q. Liang, W. Wang, X. Liu, Z. Na, and B. Zhang, Eds., Springer Singapore, pp. 1072-1079.
9. Nguyen Thi Hong Loan, Le Duy Tien, Nguyen Anh Tuan, and Le Trung Thanh (March 2022), “*Ultra-Compact All-Optical NAND Logic Gates Based on 4×4 MMI Coupler Using Silicon Hybrid Plasmonic Waveguides*”, in Recent Advances in Electrical and Electronic Engineering and Computer Science, Singapore, Z. Zakaria and S. S. Emamian, Eds., Springer Singapore, pp. 69-75.
10. Le Trung Thanh, Nguyen Canh Minh, Nguyen Van Khoi, Bui Thi Thuy, Nguyen Thi Hong Loan (2015), “*Design of silicon wires based directional couplers for microring resonators*”, The University of Danang, Journal of Science and Technology, No. 12(97), vol. 1, pp. 67-70.

Date: *Hanoi, July, 31st, 2024*

Signature:

Full name: Le Trung Thanh

Date: *Hanoi, July, 31st, 2024*

Signature:

Full name: Duong Le Minh

Date: *Hanoi, July, 31st, 2024*

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