INFORMATION OF THE DOCTORAL THESIS

Thesis title: *"Research on optical signal processing techniques applied in optical interconnects systems"*

Speciality: Computer Engineering

Code: 62.52.02.08

PhD. Candidate: 9.48.01.06

Scientific supervisors:

1. Assoc. Prof. Le Trung Thanh, PhD

2. PhD. Nguyen Ngoc Minh

Training institution: Posts and Telecommunications Institute of Technology

NEW FINDINGS OF THE THESIS

(1.) The thesis has presented a structure using MMI for implementing all-optical NAND, XOR, OR, XNOR logic gates based on silicon hybrid plasmonic waveguide. The proposed structure is based on only one 4x4 MMI cascaded with a 2x2 MMI coupler and it has advantages of ease of fabrication, large fabrication tolerance, quite large contrast ratio and high bandwidth. This new structure can be useful for optical label swapping and recogni-tion in optical packet switching networks or on-chip signal processing applications.

(2.) The thesis proposed a cascaded microring resonator with an MMI based Sagnac reflector and a structure based on 4x4 multimode interference couplers for achieving tunable Fano resonance line shapes and EIT like effect. The transmission, phase, groupdelay and pulse propagation characteristics are analyzed. The proposed structure can induce the fast and slow light bycontrolling the coupling coefficients of the couplers. The Fano Resonance and EIT-like effect based on 4x4 Multimode Interference Structures is based on 4x4 multimode interference couplers. By cascading the two independent Fano resonances, the EIT effect is achieved. This design of the proposed device is based on silicon waveguide. The whole device structure can be fabricated on the same chip using CMOS technology.

(3.) Finally, the thesis has presented two new architectures for achieving PAM-4 signals. The proposed configurations can provide good fabrication tolerance and high bandwidth, which is particularly suitable for complex systems with some channels integrated on a chip. Very low power consumption is achieved. The proposed approaches are suitable and useful for high performance computing, multicore and high speed data center systems.

APPLICATIONS, PRACTICAL APPLICABILITY AND MATTES NEED FURTHER STUDIES

Optical interconnection system, connecting microprocessors and high-performance computing systems, computing in data centers is carried out in the optical domain at 3 interconnected layers, from optical packet signal processing optical (identification, routing, header processing, ...) through optical logic gates; implement multi-level modulation for efficient transmission of optical packets, improve bandwidth while ensuring quality (PAM-4 modulation), and implement storage and delay of optical packets in the network. The thesis deals with 3 connectivity problems in optical networks applied in new generation data centers and high-performance computing systems in the optical domain.

Based on the obtained results in the thesis, future researches and development can be:

(1.) Integrate optical logic gates with active devices to create optical FPGA programmable logic circuits, optical ALU arithmetic and logic blocks to build optical computer systems.

(2.) Design optical RAM and ROM memories, thereby building CAMs (Content Addressable Memory) applied in optical computing systems on the basis of the structure of fast and slow light proposed in the thesis.

Confirmation of representative Scientific supervisor | **PhD. Candidate**

Assoc. Prof. Le Trung Thanh,PhD ……

Le Duy Tien

PhD. Nguyen Ngoc Minh……