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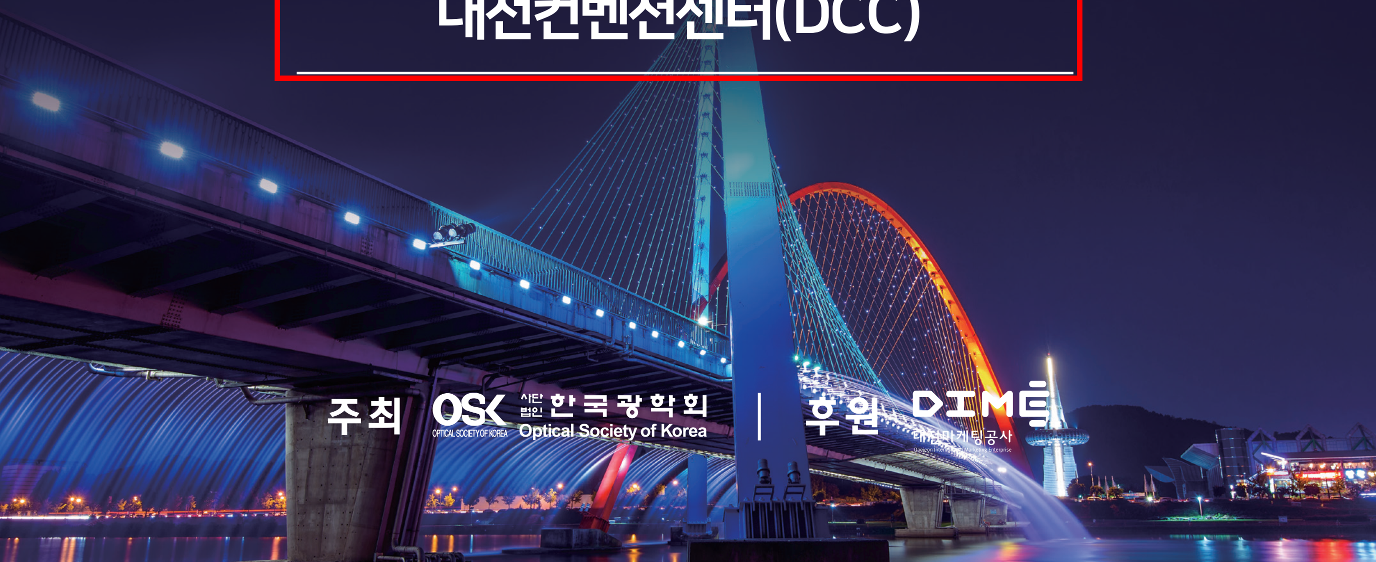
제33회
한국광학회 정기총회 및
2022 동계 학술발표회

OptoWin 2022 광산업전시회

2022. 2. 16(수) ~ 18(금)

대전컨벤션센터(DCC)



주최 OSK 사단법인 한국광학회 Optical Society of Korea | 후원 DIMe 대전마케팅공사

일 정 표

2022년 2월 18일(금, F)

시간 \ 장소	101호 (A)	102호 (B)	103호 (C)	104호 (D)	105호 (E)	106호 (F)	107호 (G)	컨퍼런스홀 (H, 3층)
09:00~10:30	광과학 III	광기술 III	디지털홀로그래피 및 정보광학 IV		양자광학 및 양자정보 III	포토닉스 III	Tutorial I 서정훈(ASML)	
	좌장: 이길주(부산대)	좌장: 김구철 (㈜아이브이유테크)	좌장: 박재형(인하대)		좌장: 정연창(ETRI)	좌장: 권용환(ETRI)	좌장: 박종락(조선대)	
	F1A-I	F1B-II	F1C-III		F1E-VIII	F1F-V	F1G-S	
10:30~10:45	Break time							
10:45~12:15	광과학 IV	광기술 IV	디지털홀로그래피 및 정보광학 V		양자광학 및 양자정보 IV	포토닉스 IV	Tutorial II 김지환(서울대)	
	좌장: 공수현(고려대)	좌장: 최주현(KOPTI)	좌장: 최희진(세종대)		좌장: 정호중(KIST)	좌장: 이정찬(ETRI)	좌장: 이승우(고려대)	
	F2A-I	F2B-II	F2C-III		F2E-VIII	F2F-V	F2G-S	
12:15~13:30	Lunch							
13:30~15:00		OptoWin 2022 광산업 세미나 II	리소그래피 II		양자광학 및 양자정보 V	포토닉스 V		
		좌장: 김상인(아주대)	좌장: 김성환(아주대)		좌장: 이창협(KRISS)	좌장: 정환석(ETRI)		
		F3B-S	F3C-IX		F3E-VIII	F3F-V		
15:00~15:15	Break time							

시간 \ 장소	1층 전시홀 (111호)
15:15~16:15	Poster Session III 광과학 (FP-I 1~6), 광기술 (FP-II 1~7), 디지털홀로그래피 및 정보광학 (FP-III 1~2), 양자전자 (FP-IV 1~6), 포토닉스 (FP-V 1~8), 디스플레이 (FP-VII 1~6), 양자광학 및 양자정보 (FP-VIII 1~4)
16:15~16:30	Break time

F3F-V : 포토닉스 V

좌장: 정환석(한국전자통신연구원)

106호 (F), 02월 18일 (금) 13:30 - 14:45

13:30 (초청강연)	F3F-V.01
	A study of implementation of high-density optical engine
	LEE Jyung Chan, LEE Joon Ki(ETRI)*
14:00	F3F-V.02
	FPGA Controller for Si Photonic MZI-Based 2 × 2 Optical Switch
	KIM Hyun-Kyu, JI Yong-Jin, SEONG Min-Hyeok, CHOI Woo-Young (Yonsei University)*
14:15	F3F-V.03
	양자 간섭을 위한 질화알루미늄 지향성 커플러 제작
	JANG Hyeong-Soon, KWON Kiwon, HEO Hyungjun, LEE Donghwa, KIM Yong-Su, HAN Sang-Wook (KIST), SHIN Heedeuk (POSTECH), KIM Sangin (Ajou University), JUNG Hojoong (KIST)*
14:30	F3F-V.04
	Microwave frequency comb generation in a niobium superconducting electromechanical device
	RYU Younghun (KAIST), SHIN Junghyun, SHIM SeungBo (KRISS), CHOI Hyoungsoon (KAIST), SUH Junho, CHA Jinwoong (KRISS)*

FPGA Controller for Si Photonic MZI-Based 2 × 2 Optical Switch

Hyun-Kyu Kim[1,*], Yong-Jin Ji[1], Min-Hyeok Seong[1] and Woo-Young Choi[1]
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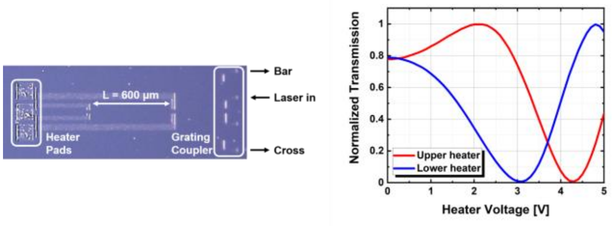
***Abstract*— We present an FPGA controller for MZI-based 2×2 optical switch. The target optical switch is fabricated in the SOI process. Our controller determines the heater voltages required for 2x2 optical switch cross or bar conditions in a manner that consumes the least amount of power. The control operation is confirmed with measurement.**

I. Introduction

There is a tremendous increase in data traffic within data centers and, consequently, the need for optical interconnect solutions with larger bandwidth are becoming stronger.(1) In addition, there are active research activities to implement the switching operation in the optical domain for future higher-performance data centers.(2) Although optical switches can circuit-switch signals containing large amount of information entirely in the optical domain, the switching operation control has to rely on electrical controllers and, consequently, implementation of switch controllers with the efficient control algorithm is essential for successful operation of optical switching systems. Furthermore, all photonic integrated circuits that are intensively investigated in recent years for such applications as quantum computing(3), machine learning accelerators(4), and photonic FPGA(5), require efficient electrical controllers. As a first step for establishing electrical controller technology for various photonic integrated circuits, we implemented an FPGA-based controller for a simple 2x2 optical switch based on the Si Mach-Zehnder Interferometer (MZI).

II. MZI-based 2 × 2 optical switch

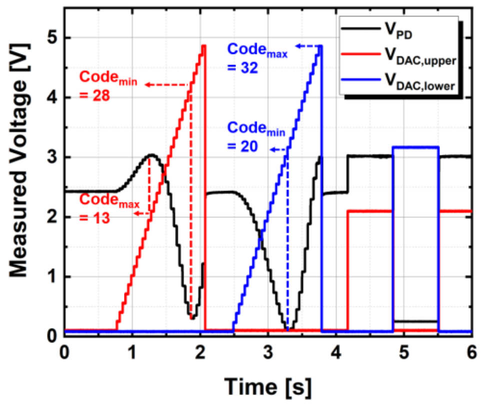


(a) (b)

[Fig. 1] (a) Chip microphotograph of the fabricated MZI-based 2×2 optical switch. (b) Optical switch characteristics with varying heater voltages.

Fig. 1(a) shows the Si Photonic MZI-based 2×2 optical switch used for the present investigation. The MZI has 600-μm long arms with built-in metal heaters for both arms. Fig. 1(b) shows the characteristic curve of this optical switch when each of two heaters are operating. Although two arms are designed to have the same length, due to process variation, there is a significant amount of phase mismatch, which needs to be compensated by the controller.

III. Operation of cross-bar voltage controller



[Fig. 2] Measured of V_{PD} and V_{DAC} when the controller operates.

Fig. 2 shows the measurement results of each heater driving voltage (V_{DAC}), and V_{PD} representing the output optical power at the cross state. The controller sweeps the heater voltages with a DAC, and determines the DAC code that maximizes V_{PD} ($Code_{max}$) or minimizes V_{PD} ($Code_{min}$) for each heater. When $Code_{max}$ for upper heater is smaller than $Code_{max}$ for lower heater as shown in the figure, indicating upper MZI arm is shorter than the lower arm, only the upper heater is needed for the cross state. For the bar state, only the lower heater is needed. The measurement results show that the controller can determine the desired switch state by applying the proper heater voltage.

References

[1] N. Farrington *et al.*, ACM SIGCOMM 2010, 339-350 (2010).
[2] P. Bakupoulos *et al.*, IEEE Communications Magazine, Vol. 56, No. 2, 178-188 (2018).
[3] X. Yan *et al.*, APL Photonics, Vol. 6, No. 7, 070901 (2021).
[4] P. R. Prucnal *et al.*, Photonics North 2020, 1-1 (2020).
[5] W. Boegarts, Opt. Fiber Comm. Conf. 2021, Tu1K.1 (2021).