Recognition Characteristics of Layered Code for Optical Time-Series
WDM Labels Using Collinear Acoustooptic Switch Arrays

Nobuo Goto¹(Univ. of Tokushima, Dept. of Optical Sci. & Tech.) and
Yasumitsu Miyazaki (Aichi Univ. of Tech., Dept. of Media Informatics)

1. Introduction

Optical label processing will be an important function in photonic label routing system. The authors have studied collinear acoustooptic (AO) devices and their applications to label recognition system using their feature of multiple-wavelength selectivity. In particular, a system consisting of AO array, optical delay waveguides and electrical multiplier has been discussed for optical codes encoded in wavelength and time domains. In this report, scalability of the optical labels is described. Increase of the number represented by the optical codes and an application to layered routing control are discussed.

2. Optical label recognition processor

The optical label recognition system consists of parallel AO processors (AOP) connected with fiber delay lines and electrical multipliers as shown in Fig.1. The AOP consists of integrated collinear AO switches and balanced photodetectors. Optical label has $M N_t$-bit partial codes and an identifying (ID) bit pulse as shown in Fig.2. Each pulse of $M$ partial codes is wavelength multiplexed with $N_t$ WDM components. Thus, the label $m$ can be represented by

$$C_{\text{label}}^m = \begin{bmatrix} c_{m1} & 0 & \cdots & c_{mN_t} \\ 0 & c_{m1} & \cdots & c_{mN_t} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & c_{mN_t} \end{bmatrix}$$

A label to be recognized is represented with frequency-multiplexed SAWs at the AO switches.
The optical code pulse train is delayed by an amount of \((N_t - l) \Delta t_p\). The output from each AO switch is converted to an electric signal by balanced detection with photodiodes. The electric pulses from the parallel AO switches are multiplied with an electrical multiplier. The multiplied output pulse trains from \(M\) parallel AOP are again multiplied with another multiplier to obtain a code-matched output pulse.

To perform code matching for partial code, the ID bit pulse plays an important role. In Fig.1, the case for obtaining \(i\)-th partial code matching is illustrated.

3. Simulation results

We consider a 9-bit \((M=3, N_t =3)\) pulse train with period of 12ps, width of 5.9ps and bandwidth of 160GHz. The WDM number \(N_t\) of each pulse is assumed to be 3. The AO interaction length \(l_{SW}\) of the switches is assumed to be 16mm. As an orthogonal code set, we employ codes \(\{a_1, a_2, a_3\}\), which are derived from an Hadamard matrix by eliminating its all-zero row and column, that is, \(a_1=(101)^t, a_2=(011)^t, a_3=(110)^t\).

Optical label for code \(C^{m}=(a_1, a_1, a_2, a_2, a_2, a_1, a_2, a_2, a_3)\) is shown in Fig.3. It is noted that the wavelength of the ID bit pulse is \(\lambda_1\). When SAWs at the AOPs are set for matching \(C^{1}=(a_1, a_1, a_1, a_2, a_2, a_2, a_2, a_2, a_3)\) and \(C^{2}=(a_1, a_1, a_1, a_2, a_2, a_3, a_1, a_2, a_3)\), the electric output from the electrical multiplier is obtained as shown in Fig.4. The output for unmatched codes is less than -20dB. Since the unmatched code \(C^{3}\) has an unmatched partial code in the 2\(^{nd}\) part, the partial matched outputs for the three partial codes are obtained as shown in Fig.5.

4. Conclusion

The optical label matching for the whole code and partial codes can be used for layered structure code, which will be useful, for example, in QoS routing control. We will further discuss the whole routing system including experimental verification.

References