Correspondence

Comments on "Novel Combinatorial Constructions of Optical Orthogonal Codes for Incoherent Optical CDMA Systems"

Cheing-hong Lin and Jingshown Wu

In the above paper [1], the balanced multiuser interference (MUI) cancellation decoder shown in [1, Fig. 1(b)] is erroneous and cannot function. The authors state that this balanced decoding scheme allows the MUI cancellation in the case when unipolar sequences having in-phase cross correlation 0 or 1 are employed. The mutual in-phase cross correlation of two code sequences $x = (x_1, x_2, \ldots, x_v)$ and $y = (y_1, y_2, \ldots, y_v)$ is defined as

$$R_{x,y} = \sum_{n=1}^{v} x_n y_n. \quad (1)$$

It is assumed that the signal at the upper photodiode is proportional to $R_{x,x} + R_{x,y}$ and the signal at the lower photodiode is proportional to $R_{x,y}$, where x is the desired sequence and y is the interfering sequence. Hence, the MUI can be completely removed with balanced detection [1].

However, the above statement is not true. In the upper branch of the balanced MUI cancellation decoder, since the fiber Bragg grating (FBG) array employed in this branch has the spectral distribution $x(\lambda)$ corresponding to the code sequence x, the signal at the upper photodiode is indeed proportional to $R_{x,x} + R_{x,y}$. But in the lower branch, since the FBG array has the complemental spectral distribution $\overline{x}(\lambda)$, the signal at the lower photodiode should also be proportional to $R_{x,x} + R_{x,y}$ as shown in Fig. 1 (because the spectral components corresponding to $x(\lambda)$ will pass through this FBG array completely). Therein, $S(\lambda)$ is the spectral distribution of the received optical signal and $y(\lambda)$ is the spectral distribution corresponding to the code sequence y. Hence, if this balanced decoding scheme is employed, there will be no signal appearing at the output.

This problem might be caused by a mistake made by the authors during the preparation of the drawings. The balanced MUI cancellation decoder should be revised as shown in Fig. 2. Unfortunately, this decoder can work only when $R_{x,y} = R_{\overline{x},y}$. It means that the in-phase cross correlation of any two code sequences must be fixed and equal to half of the code weight. Since the in-phase cross correlation for any of the optical orthogonal code (OOC) families based on mutually orthogonal Latin rectangles (MOLRs), integer lattice design, and affine geometries (AGs) proposed by the authors is not fixed and is not equal to half of the code weight—the decoder shown in Fig. 2 cannot be used to decode these code families.

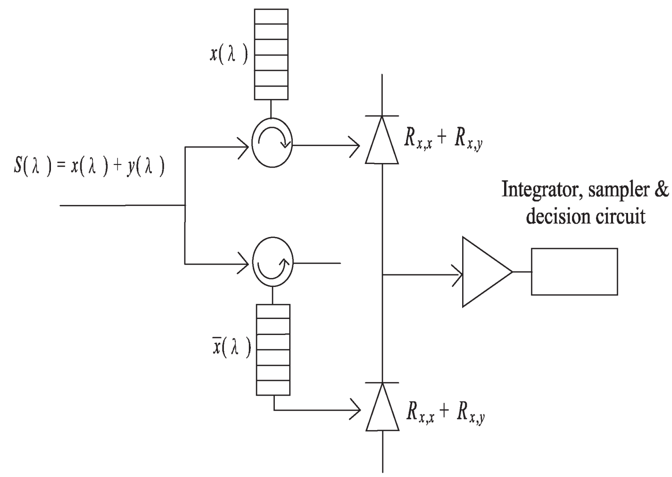

Fig. 1. Balanced MUI cancellation decoder scheme proposed in [1].

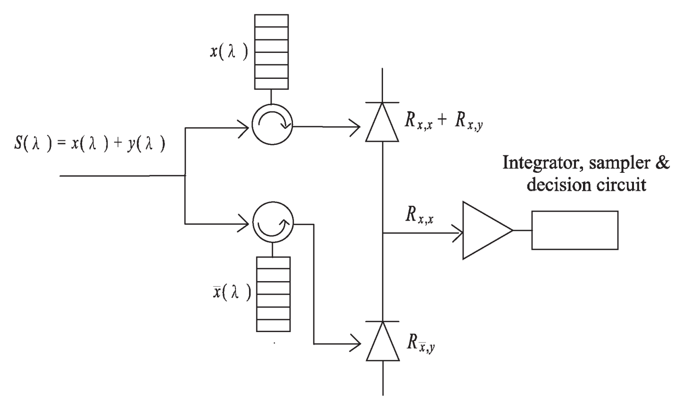

Fig. 2. Revised structure of the balanced MUI cancellation decoder.

In summary, the balanced MUI cancellation decoder shown in [1, Fig. 1(b)] is erroneous and therefore cannot be used to decode the proposed code families based on MOLRs, integer lattice design, and AG. In order to make these code families applicable to spectral-amplitude-coding systems, the authors may need to propose another decoding scheme to solve this problem.

References

[1] I. B. Djordjevic and B. Vasic, "Novel combinatorial constructions of optical orthogonal codes for incoherent optical CDMA systems," *J. Lightw. Technol.*, vol. 21, no. 9, pp. 1869–1875, Sep. 2003.

Manuscript received August 13, 2004.

The authors are with the Department of Electrical Engineering and Graduate Institute of Communication Engineering, National Taiwan University, Taipei, Taiwan 10617, R.O.C.

Digital Object Identifier 10.1109/JLT.2005.861938

0733-8724/$20.00 © 2006 IEEE