Sharif University of Technology
Electrical Engineering Department

Master of Science Thesis

Analysis and Design of Optical Orthogonal Codes Using Matrix Algebra

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Abstract – An Optical Orthogonal Code (OOC) is a family of (0,1) sequences that have good auto- and cross-correlation properties. Optical orthogonal codes have been introduced for use in Fiber-Optic Code-Division Multiple-Access (FO-CDMA) networks and recently been introduced for applications in Radar, Sonar, etc. In this thesis, the mathematical origins of optical orthogonal codes are first examined and various algorithms are studied. In particular, with study the use of matrix algebra for analyzing the codes, we begin by introducing the circulant matrices corresponding to OOCs and present a detailed definition of OOC based on circulant-matrices space as a commutative algebra. Then, using the eigenvalues of circulant matrices, we establish a partitioning algorithm on the space of constant-weight sequences which we refer to as the spectral classification. By presenting the multiplicative permutation method for spectral classification of the space, we prove the properties of each class and give some suggestions on the OOC design techniques.

Index Terms
1. Optical Orthogonal Code
2. Circulant Matrix
3. Spectral Classification
4. Multiplicative Partitioning