

Preface

Walsh functions form a closed set of orthogonal functions over a prespecified interval, each function taking merely one constant value (either +1 or -1) in each of a finite number of subintervals into which the entire interval is divided. Order of a Walsh function is equal to the number of zero crossing within the interval. Walsh functions are extensively used in communication theory and microwave engineering, and in the field of digital signal processing. One of the authors (LNH) pioneered the use of Walsh functions in the treatment of problems of optical imagery and beam shaping. Lossless phase filters play the key role in these ventures. Walsh filters, derived from Walsh functions, have opened up new vistas. They take on values, either 0 or π phase, corresponding to +1 or -1 value of the Walsh function.

In general, members of the set of Walsh functions are not self-similar; but the set can be classified into distinct self-similar groups and subgroups, where members of each subgroup possess distinct self-similar structures. Self-similarity is observed in the farfield diffraction patterns obtained on the focal/image plane of optical imaging systems when the corresponding self-similar filters are used for pupil plane filtering. Self-similarity is also observed in the three-dimensional (3D) light distributions around the focus obtained by use of self-similar pupil plane Walsh filters. Our observations on the same are put forward in the monograph. They provide valuable clues in tackling the inverse problem of synthesis of phase filters for prespecified distribution of intensity on the transverse image/focal plane, or general problem of prespecified 3D distribution of intensity around the image/focal plane.

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