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It is well known that central problems in the design of uter hardware (e.g., minimization of systems of boolean tions, state assignment for sequential machines, test ration for logical networks, etc.) are NP-hard [1-3], this ies that any algorithm for the optimal solution of these lems will require an exponential number of steps. This is same order of complexity as that of a 'brute-force' approach, d on a comparison all possible solutions. The situation ars even more difficult when noting the dramatic increase in ce complexity with the transition to very large scale gration (VLSI) technologies. Due to this difficulty, there growing demand for analytical design techniques useful for and complex devices. This situation is similar to that in design of optimal control systems. Here, the system is first rized and then an optimal approximating linear system is gned by the use of such powerful techniques as the Laplace sform, the Fourier transform, or Z-transform. The spectral iques presented in this book are similar to these classical sforms: in fact, they maintain the basic properties of the ace and Fourier transforms. They may be considered as ralizations of these classical transforms for the analysis esign of digital devices, both binary and non-binary.

An intrinsic advantage of the Laplace and Fourier transforms hat many problems which are difficult to solve in the nal or 'time' domain have simple solutions in the transform

ISBN 0-12-400060-6

respect to the spectral techniques discussed in this volume.

Consider a combinational network (Fig.1) with m binary input lines $x_0,\dots,x_{m-1}$ and k binary output lines $y_0,\dots,y_{k-1}$. This device can be described by the function

$$y = f(x) \qquad (x = \sum_{j=0}^{m-1} 2^j x_j,\ y = \sum_{j=0}^{k-1} 2^j y_j \quad,\ x_j,\ y_j \in \{0,1\}). \qquad (1)$$

Let us introduce now a transform $W: f \longrightarrow \hat{f}$, as an analog to the Fourier transform, for the system f of Boolean functions:

$$\hat{f}(\omega) = 2^{-m} \sum_{x} f(x)\, W_\omega(x) \ , \qquad (2)$$

where $\omega = \sum_{j=0}^{m-1} 2^j \omega_j \qquad (\omega_j \in \{0,1\})$ and

$$W_\omega(x) = W_x(\omega) = (-1)^{(x,\omega)} = (-1)^{\sum_{j=0}^{m-1} x_j \omega_j} \qquad . \qquad (3)$$

Fig. 1. Block diagram of a combinational network.

$\to f$ is known as the Walsh transform or as the Walsh-Hadamard transform. A $(2^m \times 2^m)$ - matrix with elements $W_{x,\omega} = (-1)^{(x,\omega)}$ called the Hadamard matrix.

The inverse Walsh transform $W^{-1}: \hat{f} \to f$ is defined by

$$f(x) = \sum_{\omega} \hat{f}(\omega)\, W_{\omega}(x) = \sum_{\omega} \hat{f}(\omega)\, (-1)^{(x,\omega)} \ . \qquad (4)$$

function $\hat{f}(\omega)$ is known as the Walsh image, or the Walsh ctrum, of the original function $f(x)$ and ω is called as a eralized frequency'.

There are quite a few important design problems that are y difficult to solve using the original function $f(x)$, yet y easy to solve using the spectrum $\hat{f}(\omega)$. Some of these blems will be considered in Chapters 1,2,3,4,5, and, 7 of this t.

Before we discuss applications of the Walsh transform, let riefly review the basic properties of the Walsh functions and Walsh transform. (For a more detailed description and proofs roperties of the Walsh transform, see [5-7].)

First we note that the Walsh functions $\{W_{\omega}(x) = (-1)^{(x,\omega)}$, $(\omega_0,\ldots,\omega_{m-1})$, $x = (x_0,\ldots,x_{m-1})\}$ form a complete set of ogonal functions, i.e.

$$2^{-m} \sum_{x} W_{\omega}(x)\, W_t(x) = \delta_{\omega,t} \ , \qquad (5)$$

e $\delta_{\omega,t} = \begin{cases} 1, & \omega = t \\ 0, & \omega \neq t \end{cases}$; and if

$= \sum_{x} f(x)\, W_{\omega}(x) = 0$ for all ω, then $f(x) = 0$ for all x.

are related to the group structure of the set of binary vectors.

A set G is said to be a group with respect to operation * iff: for any a,b G we have a*b G, there exists 0 G such that a*0=0*a=a for any a G, and for any a G there exists a^{-1} G such that $a*a^{-1} = a^{-1}*a=0$. A group G is said to be commutative (Abelian) if for any a,b G a*b=b*a. Two groups, G_1 with operation * and G_2 with operation o, are said to be isomorphic iff there exists a one-to-one mapping (isomorphism) $h:G_1 \longleftrightarrow G_2$ such that h(a*b)=h(a)oh(b) for any $a,b \in G_1$.

The set of Walsh functions form a multiplicative group

$W_0(x) = 1$ for all x and

$$W_\omega(x)\ W_t(x) = W_{\omega \oplus t}(x) \ , \qquad (6)$$

where $\omega \oplus t$ is a componentwise modulo-2 addition (XOR operation) of binary m-vectors ω and t.

From (6) and (3) we also have the following 'translation of arguments' property

$$W_\omega(x \oplus \tau) = W_\omega(x)\ W_\omega(\tau) \ . \qquad (7)$$

The most important property of Walsh functions is that the multiplicative group of Walsh functions is isomorphic to the dyadic group F_2^m of all binary m-vectors with respect to the componentwise XOR operation. The importance of this property follows from the fact that all logical functions describing behavior of combinational computer components are defined over the dyadic group F_2^m. This isomorphism, $h:W_\omega(x) \longleftrightarrow \omega$, is similar to the isomorphism between the multiplicative group of the exponential functions $\exp(i \frac{2\pi}{N} x\omega)$ $(i = \sqrt{-1})$ and the additive group of integers $\{0, \pm 1, \pm 2, \pm 3, \ldots\}$.

We shall summarize now the most important properties of the Walsh transform $W:f \longrightarrow \hat{f}$ (i.e., of the harmonic analysis over the dyadic group) which will be widely used throughout this book.

$f(x) = \sum_{i=1}^{s} a_i f_i(x)$, where a_i are arbitrary realnumbers.

Then $\hat{f}(\omega) = \sum_{i=1}^{s} a_i \hat{f}_i(\omega)$. (8)

Translation of Arguments

$\rho(x) = f(x \oplus \tau)$ for some $\tau \in F_2^m$.

$\hat{\rho}(\omega) = W_\tau(\omega)\ \hat{f}(\omega)$. (9)

Logical Convolution

te $\rho = f_1 \circledast f_2$, for $\rho(\tau) = \sum_x f_1(x)\ f_2(\tau \oplus x)$. (10)

$$\widehat{f_1 f_2} = \hat{f}_1 \circledast \hat{f}_2 ,$$

$$2^{-m}\ \widehat{f_1 \circledast f_2} = \hat{f}_1\ \hat{f}_2 . \quad (11)$$

Plancherel Theorem

$$2^{-m} \sum_x f_1(x)\ f_2(x) = \sum_\omega \hat{f}_1(\omega)\ \hat{f}_2(\omega) . \quad (12)$$

Poisson Summation Theorem

Let V be a subgroup of the dyadic group F_2^m of binary m-
ors and $V^\perp$ be the orthogonal subgroup

$\{(x_0,\ldots,x_{m-1}) \mid x_0Z_0 \oplus x_1Z_1 \oplus \ldots \oplus$
$_1Z_{m-1} = 0$ for all $(Z_0,\ldots,Z_{m-1}) \in V\}$.

$$^{-1} \sum_{x \in V} f(x) = \sum_{\omega \in V^\perp} f(\omega) \quad (13)$$

e $|V|$ is the number of elements in V.

pectral characteristic of switching functions, namely, the ogical autocorrelation function B, which may be defined for the iven system f of switching functions as

$$B(\tau) = \sum_{x} f(x)\, f(x \oplus \tau) \quad . \tag{14}$$

The following important result, which is an analog of the ell-known Wiener-Khinchin theorem in the theory of stochastic rocesses, shows the relation between the autocorrelation unction and the Walsh transform

$$B = 2^{2m}\hat{f}^2 \quad . \tag{15}$$

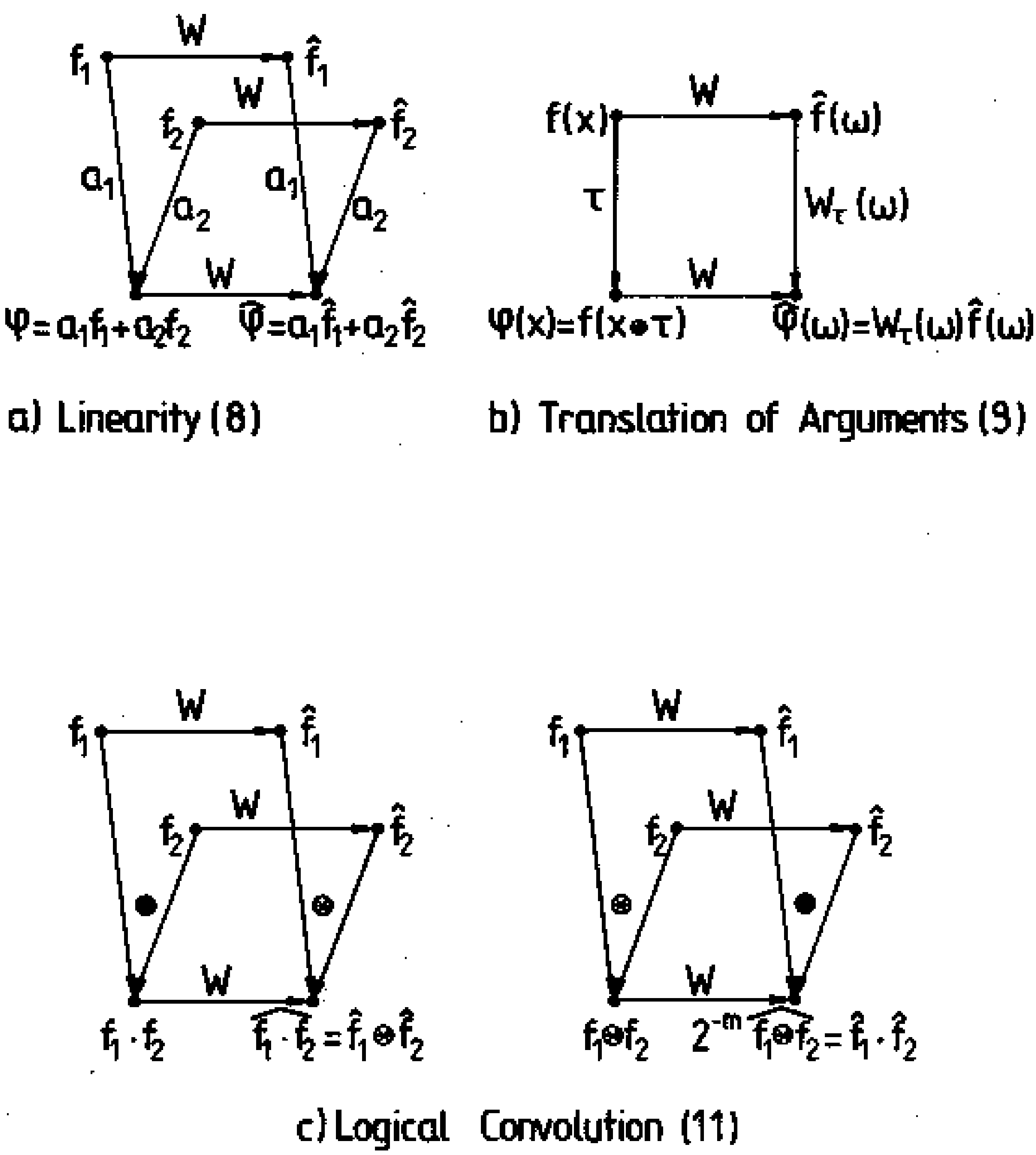
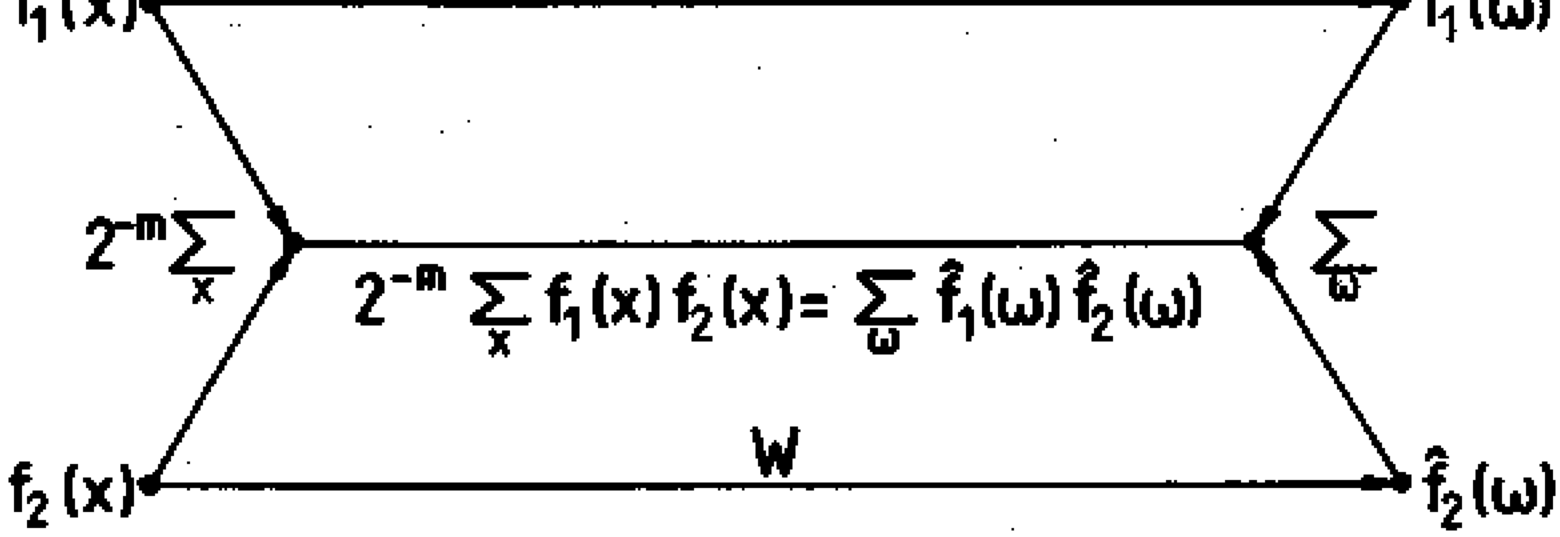
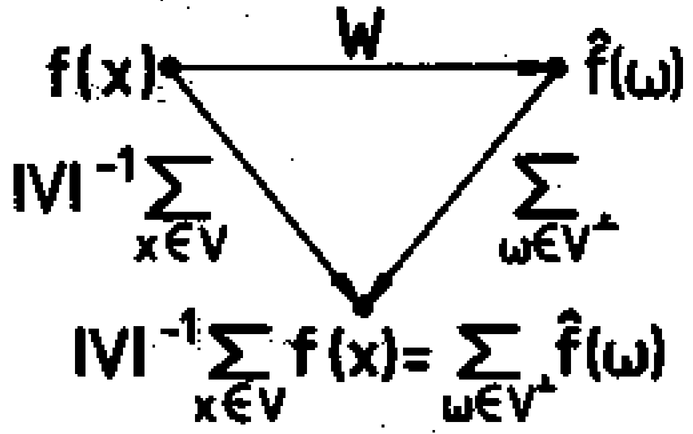


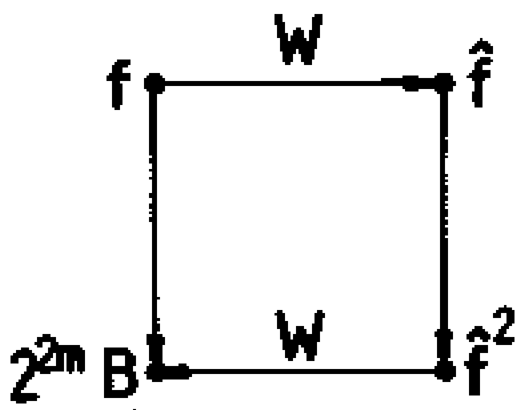
Fig. 2. Properties of the Walsh transform.



d) Plancherel Theorem (12)



e) Poisson Theorem (13)



f) Wiener–Khinchin Theorem (15)

Fig. 2. Properties of the Walsh transform (cont'd).

ccessive application of the Walsh transform to the original nction f. (Relations (8)-(15) are illustrated by Fig.2)

We note that the logical autocorrelation function is variant under the dyadic shift (i.e., functions f(x) and f(x have the same autocorrelation for any binary vector $t \in F_2^m$). e spectrum $\hat{f}(\omega)$ and the autocorrelation function $B(\tau)$ will be e most important analytical tools used in this book for ectral design techniques.

We also note that the basic properties (8) - (15) of the lsh transform are very similar to the corresponding properties the Laplace or the Fourier transforms, the major difference is e replacement of addition (or subtraction) by componentwise dulo 2 addition. To compute the Walsh transform $f(x) \to \hat{f}(\omega)$ e can use the Fast Walsh Transform algorithm [5,8,9,124]. For $\omega \in F_2^m$ this requires $m2^m$ additions and subtractions, and 2^m mory cells. This indicates that it is quite feasible to mpute Walsh transforms and logical autocorrelations for systems Boolean functions of, say, 20 arguments using modern mputers. Tables of Walsh transforms and logical tocorrelations for different classes of Boolean functions may found in [5].

The Walsh transform can be generalized to the case of non-nary (p-ary, p>2) functions. This is relevant, for example, to age processing (see Chapter 3 and Chapter 5) and digital ltering (see Chapter 4). In this case Walsh functions $W_\omega(x)$ e replaced by the generalized Walsh (or Chrestenson) functions (x) where

$$\chi_\omega(x) = \exp\left(i \frac{2\pi}{p} \cdot \sum_{j=0}^{m-1} x_j \omega_j\right) \quad (i=\sqrt{-1}), \tag{16}$$

ven that $x = \sum_{j=0}^{m-1} p^j x_j$, $\omega = \sum_{j=0}^{k-1} p^j \omega_j$, $x_j, \omega_j \in \{0,1,\dots,p-1\}$.

fined at points 0,1, ..., N-1 may be considered as a special se of the Chrestenson transform for p=N and m=1.

All basic properties of the Walsh transform can be easily neralized to the case of the Chrestenson transform (see [5]). he Walsh transform is a special case of the Chrestenson ansform for p=2).

The Chrestenson transform may be considered as a Fourier ansform over the group F_p^m of all p-ary m-vectors (p not cessarily prime) with respect to the operations of mponentwise modulo p addition.

To generalize the Walsh or the Chrestenson transforms to the se of an arbitrary commutative group G (e.g. when different mponents of vector x belong to the different alphabets, x_j , and the group operation in G is the componentwise addition, h components added modulo $|G_j|$, j=0,...,m-1) one should replace eChrestensonfunctions(16) by the characters of thegroup G haracters χ_ω are homomorphisms of G into the multiplicative oup of roots of unity, i.e. for any x, z $\in$ G $(x*z)=\chi_\omega(x)\chi_\omega(z)$ where * is the operation in G and $|\chi_\omega(x)| =$ $_\omega(Z)|=1$. Walsh functions and Chrestenson functions are aracters of F_2^m and F_p^m correspondingly) [5]. These generalized urier transforms may be further generalized to the case when G a noncommutative group (for example, when x $\in$ G is a rmutation of input terminals). In this case characters should replaced by unitary irreducible representations of G, which e matrix-valued functions defined over the group G [10,11]. neralized Fourier transforms over arbitrary finite commutative d non-commutative groups will be used in Chapter 3 and Chapter

In conclusion, we again note that all the basic properties the Walsh transform (8)-(15), including the Fast Walsh ansform algorithm, may be generalized to the Fourier transform er any finite group G [11]. Generalizations of the Walsh and elds. These are known as the Walsh-Galois and the restenson-Galois transforms [5,10,12].

The Walsh transform and its generalizations have been widely ed in the analysis and design of digital devices. We will esent below a very brief summary of these applications.

The earliest applications of the Walsh transform have been the areas of Boolean functions classifications, design chniques for logical devices and data transmission.

Spectral approaches for Boolean function classifications ve been presented in [13, 14, 15, 19] and for the design of gical devices in [5,14 - 21,113,120]. Applications of the lsh transform for data transmission started with the pioneering rk of Harmuth [22] and continued in [23 - 26,38]. Spectral chniques have been also widely used in the theory of error-rrecting codes and in particular for the proof of MacWilliams entities [27]. In addition, they have been useful to mpute weight distributions of linear codes [28] and their sets [29].

The Chrestenson transform has been used in multiple-valued gic (especially ternary logic), for design of devices with many ables states [30 - 35,118,119], and in the theory of non-binary ror-correcting codes [27 - 29].

Another area where the Walsh transform and Walsh-related ansforms have been widely used is signal processing, especially age processing and pattern analysis [6, 36-43]. The Walsh ansform and its generalizations have also been used for digital ltering, construction of suboptimal Wiener filters and analysis tradeoffs between the statistical performance of a filter and s computational complexity [42, 43, 122, 123, 125].

Spectral techniques for testing of logical networks by rification of the coefficients in the spectrum or in the tocorrelation function have been developed in [51 - 54, 117]. e problem of constructing optimal data compression schemes by ticularly useful for compressing test responses of gical networks [44, 45], of memories [50], and for testing nerical computations [46, 47, 48]. Spectral techniques for iability analysis of logical networks has been presented in ; – 58,120].

In this book, Chapters 1 and 2 are devoted to applications spectral techniques for logical design. Chapter 3 deals with plications of these techniques to pattern analysis, and Chapter vith applications to digital filtering. Computer architectures spectral processing and pipelining of data by cellular arrays presented in Chapter 5. Here the presentation is made with phasis on signal and image processing and on generalized ctral estimation algorithms.

Chapters 6, 7, 8, and 9 focus a special attention on the blems of testing, fault detection and correction in computer dware.

With the advent of LSI and VLSI technology the growing costs test generation and application of is becoming a real ttleneck of the computer industry. The major reasons for this poor controllabilities and observabilities of internal nodes complex devices and limited numbers of output pins. The time d the cost of testing increases tremendously (in general, ponentially) with the growing complexity of the devices to be sted. In many cases, this cost is higher than the cost of velopment and manufacturing. 'The majority of direct labor time quired to build an Apple III is straight test time... If the st and the rework time is added together, 72% of the process me is accounted for' [59]. We may also recognize that nerating an optimal test for detecting single stuck-at faults ly is already an NP-hard problem (i.e., the number of steps in y test generation procedure grows exponentially with the crease of the number of gates in the device under test) [2,3].

tworks is the choice of a fault model. The fault model may pend on the device's logical structure, its electrical nfiguration and the environment where this device is to be ed. The following fault models have been widely used: single d multiple stuck-at faults [61, 62, 83, 87], intermittent ransient, or soft) faults [87, 57, 58, 110], single and ltiple bridging (short-circuit) faults [83, 105-108], pattern nsitive faults for semiconductor memories [83, 109], and stuck--open faults for CMOS devices [111, 112]. Stuck-at faults, idging faults and intermittent faults are presently the most pular fault models in use. The stuck-at fault model is used in apters 6, 7 and 8 of this book, the bridging fault model in apter 6, and the intermittent fault model in Chapter 9.

For testing of small and medium scale integration devices te-level approaches have been widely used. In this case the put data for test generation consists of a gate-level scription of a device under test and a gate-level description a class of possible faults. These gate-level test generation ocedures have been based on the ideas of path sensitization 3], Boolean difference [61] and the D-algorithm [62, 116]. The olean difference (derivative) $\partial f/\partial x_i$ with respect to x_i for the olean function $f(x_0,\dots,x_{m-1})$ is defined as

$$\partial f/\partial x_i \quad (x_0,\dots,x_{i-1},x_{i+1},\dots,x_{m-1}) = f(x_0,\dots,x_{i-1},0,x_{i+1},\dots,x_{m-1}) \oplus f(x_0,\dots,x_{i-1},1,x_{i+1},\dots,x_{m-1}) \; . \tag{17}$$

e single stuck-at-1 (stuck-at-0) fault at line x_i is detected a test vector $t = (t_0,\dots,t_{m-1})$ iff, respectively,

$$t_i \; \partial f/\partial x_i \; (t_0,\dots,t_{i-1},t_{i+1},\dots,t_{m-1}) = 1 \tag{18}$$

$$(t_i \; \partial f/\partial x_i \; (t_0,\dots,t_{i-1},t_{i+1},\dots,t_{m-1}) = 1) \; .$$

modifications, have been and still are very useful for small
d medium size devices, this is especially true for devices
ere design for testability guidelines [63, 87, 115] have been
plemented. With the transition to VLSI technology there is a
owing demand to develop more efficient testing procedures.
ere are several reasons for this. First of all, for VLSI
vices, a gate-level description of the device is very complex
d may not be available at all (to individual users). Even if
gate-level description is available to a test designer, the
st of test generation, is in many cases, prohibitively high for
SI devices. These considerations stimulated the development of
functional testing approach as a viable alternative to gate-
vel testing, especially in the case of microprocessor testing.

For functional testing, the input data for test generation
nsists of a functional description of the circuit and of a
ass of faults [64-68]. For the functional testing of a
croprocessor, the functional description may be a register-
ansfer-level one, and typical functional faults may be
placements of an instruction by another one, replacements of an
struction by no instruction or two instructions, etc.
,65,67,68].

Functional testing techniques have been successfully used
many years for testing of complex devices. Nevertheless, for
se approaches, the cost of VLSI test generation is very high,
ecially when a broad spectrum of devices has to be tested. In
lition, it is difficult to estimate the effeciency of a
actional test. For example, the percentage of faults of a
ven class, say single stuck-at faults, which are detected by
test may be difficult to calculate. In many cases the only
to estimate this fault coverage for a functional test is to
rform a computer simulation using a large set of faults.
fortunately, software packages for the simulation are very
pensive, and lengthy CPU times may be required to run these

In view of these difficulties, there is a growing tendency n the VLSI environment to eliminate as much of test generation s possible. The following four approaches have been used to chieve this goal:

1. universal standard tests for various classes of faults,
2. exhaustive or random testing, in combination with various data compression schemes, for the generation of test data and compression of test responses,
3. design for testability,
4. built-in self-testing approaches based on introducing redundancy into a device in order to provide self-error-detecting/correcting capabilities.

hese approaches are considered in Chapters 6, 7, 8 and 9 of this ook.

Fortunately, the same factors that make the problem of test eneration for VLSI devices so difficult, namely, the increasing omplexity and large diversity of the circuits, facilitate nother approach known as universal testing [69-72]. Based upon robabilistic considerations, universal tests are designed to etect all faults of a given class in almost all devices. The raction of devices in which universal tests detect all the aults of a given class, approaches one rapidly as the number of nput lines for the circuit under test grows. For all practical urposes, this fraction can be put equal to one for the number of nput lines $m \geq 20$. The transition from functional to universal esting is similar in principle to the transition from mechanics o statistical mechanics. The major breakthrough in ommunication engineering due to Shannon's information theory was ased on very similar ideas.

The universal testing approach is presented in Chapter 6. or this approach, one does not try to develop a test for a pecific device, but rather to construct a deterministic standard est that can then be used for a large set of devices. Note that

roaches suggested in [75 - 78] may be considered as special
it cases of universal testing. The universal testing approach
further aimed to fill the gap between functional and random
ting and to combine some advantages of both. For universal
ting, the input data for test generation consists of
ameters of the device under test (e.g., numbers of input and
put lines, flip-flops, etc.) and a description of a class of
sible faults (e.g., stuck-at faults of a given multiplicity).
erally speaking, universal tests require less test patterns
n random tests but more than functional ones.

There are some similarities between random and universal
ting, for instance, both approaches ignore the specific
tures of the device under test. Nevertheless, there are
ential differences between these approaches that lead to
ferent test sizes and fault detecting capabilities, and
refore these similarities may be misleading. First, universal
ts are designed in a deterministic manner, where not only the
t patterns but also their sequential order may be essential.
the other hand, the generation and application of random test
terns are intrinsically stochastic. Second, we note that in
trast with random testing, universal tests are fault oriented:
. they are designed for a specific class of faults.

Universal tests are efficient when a broad spectrum of
plex VLSI devices should be tested, and a small probability of
detecting all the errors of a given class can be tolerated.

Chapter 6 presents universal tests and the corresponding
babilities of fault detection for single and multiple stuck-at
bridging faults at input/output lines and faults in flip-
ps. A detailed comparative analysis of universal vs.
ctional and universal vs. random testing is also presented in
pter 6.

Another approach to testing that does not require a complex
t generation procedure is that of random or exhaustive

o millions of test patterns. In order to efficiently monitor est responses it is necessary to compress the output streams. he compression of an output sequence of, say, 10^6 bits may esult in a 16-bit signature that is to be monitored for fault etection or fault location. The optimal choice of a data ompressor for a given class of errors is very difficult to efine. In addition, the probability of masking an error by a iven data compressor must be estimated. (Note that we mean by rror a manifestation of a fault at the output of a device under est.)

Chapter 7 presents spectral techinques for data compression. hese techniques are based on verification of some precomputed pectral coefficients $\hat{f}(\omega)$, where $\hat{f}$ is the Walsh transform of a ystem of Boolean functions, f, describing the behavior of the ault-free device.

Another approach to the compression of test data makes use f single or multiple input linear feedback shift registers LFSR), which are shift registers with XOR gates in their eedback loops [79, 80]. For this approach, as well as for lmost all other known data compression techniques, (like syndrom esting [73, 74], or transition counting [81, 82, 83]), data ompressors are sequential devices implementing 'time ompression' of an output data stream.

A different approach to the same problem is based on the dea of 'space compression' [84,121]. In this case the data ompressor is a combinational device with a smaller number of utput lines than that in the device under test. Only output ines of the 'space compressor' are monitored for testing. The heories of 'space data compression' [84] and 'time data ompression' [79, 80, 84, 121] are related to the theories of inear error-correcting codes and cyclic error-correcting codes, espectively. The best 'space' or 'time' data compressors for he given class of errors correspond to decoders of optimal

A survey of data compression techniques useful for fault
ection and fault location (diagnosis) is presented in Chapter
A special attention in this chapter is devoted to linear
dback shift registers (LFSRs), since at the present time these
the most popular tools for compressing test responses.
ost all results published in this area are devoted to
lications of LFSRs for fault detection. A survey of these
ults and new results on fault diagnosis by LFSRs are presented
Chapter 8.

Since testing remains very expensive while the cost of
dware is decreasing, there is a growing interest in using
lt-in on-line concurrent self-tests. In this case, working
testing modes are combined, and a redundancy is introduced to
vide self-error-detecting and/or self-error-correcting
abilities. A built-in self-test may be efficiently used for
ecting not only stuck-at faults but intermittent faults as
l. (Note that gate-level, functional, random and universal
ting approaches, as described above, are not efficient for
ecting intermittent faults.) On the other hand, it is very
ficult to test networks with built-in fault correction.
The following techniques have been considered for self-error-
ection and correction: replication, 'interwoven logic', and
or correcting codes.

For replication techniques several copies of a device are
d, and outputs of these copies are compared for fault
ection [85-87], or a special threshold element ('voter') is
d to correct, (or 'mask') errors [87-88]. Note that voters
emselves may also be replicated [87]. Different
configuration, self-purging replication and adaptive voting
hniques have been suggested [87, 113, 114]. When a faulty copy
identified by comparing its output with the output of the
er, the faulty copy is automatically switched out and a spare
y switched in. In spite of the fact that replication

ilitary and civil applications, especially in the form of uplication and triplication.

Another set of well-known approaches for self-error-orrection, is referred to as 'interwoven logic' [89 -93]. Here e are trying to construct a network in such a way that the gates t any given level in the network will mask a maximal number of rrors that appear in the gates and lines of the previous level. his approach results in redundant inputs to each gate to provide or gate-level fault-masking. A major disadvantage of the interwoven logic' is that its implementation results in very igh redundancy, which may even decrease the reliability of the hole system.

In view of all this, there is a growing interest in the pplication of error-detecting and error-correcting codes for the esign of reliable devices. The simplest form of these echniques is parity checking. We also note that replication echniques may be considered as a special case of the application f error-correcting codes. (These are called 'repetition codes', ith a small transmission rate, but a very simple decoding rocedure [87]). Techniques for a reliable design based on rror-detecting and error-correcting codes may be efficiently sed for designing control sections of computers. The behavior f a control section may be described by the finite automaton sequential machine) model. Here, error-detecting and error-orrecting codes may be used for the finite automaton's state ssignment or for a reliable implementation of the corresponding equential network's combinational part. In the latter case we dd a few input and output lines for every logical subnetwork. his is done in such a way that input and output vectors of the ault-free subnetwork are codewords of the chosen code [87, 96 - 04]. This approach is promising since it results in high-speed ogical networks with distributed error detection or correction. hapter 9 provides further details for this approach.

Garey, M.R., Johnson, D.S. (1979). "Computers and Intractability. A Guide of NP-Completeness", W.H. Freeman and Co.

Ibarra, A.K., Sahni, S. (1975). "Polynomially Complete Fault Detection Problems", IEEE Trans on Comp., C-24, p. 242-248.

Sahni, S., Bhatt, A. (1980). "The Complexity of Design Automation Problems" Proc 17th Design Automation Conf., Minneapolis, MN, p. 402-411.

Karpovsky, M.G., Moskelev, E.G. (1972). "Spectral Methods for Analysis and Synthesis of Switching Circuits," Energy, USSR.

Karpovsky, M.G. (1976). "Finite Orthogonal Series in the Design of Digital Devices," John Wiley and Sons.

Beauchamp, K.G. (1975). "Walsh Functions and Their Applications". Academic Press.

Hurst, S.L. (1978). "The Logic Processing of Digital Signals, New York, Crane Russak Co.

Elliot, D.F., Rao, V.R. (1982). "Fast Transforms: Algorithms, Analysis, Applications", New York, Academic Press, 1982.

Andrews, H.C., Caspari, K.L. (1970). "A Generalized Technique For Spectral Analysis", IEEE Trans on Comp., vol C-29, p. 16-25.

Karpovsky, M.G., Trachtenberg, E.A. (1977). "Some Optimization Problems for Convolution Systems over Finite Groups," Information and Control, vol. 39, p. 1-2.

over a Finite Non-Abelian Group", IEEE Trans. on Comp., C-26, No. 10, p. 1028-1031.

. Karpovsky, M.G., Trachtenberg, E.A. (1979). "Fourier Transforms Over Finite Groups for Error Detection and Error Correction in Computation Channels", Information and Control, vol 40, No. 2, p. 335-359.

. Ninomia, I. (1961). "A Study of the Structure of Boolean Functions and Its Application to the Synthesis of Switching Circuits", Mem. Fac. Eng Nagoya Univ., 13(2).

. Lechner, R.J. (1961). "A Transform Approach to Logic Design," IEEE Trans on Comp., C-19(7), p. 672-680.

. Lechner, R.J. (1971). "Harmonic Analysis of Switching Functions", Ch. 5 of "Recent Development in Switching Theory," A. Mukhopadhyay et al, Academic Press.

. Karpovsky, M.G., Moskalev, E.S. (1967). "Realization of a System of Logical Functions by Expansion in Orthogonal Series", Automat. and Remote Control, Vol. 28, N 12, p. 1921-1932.

. Karpovsky, M.G., Moskalev, E.S. (1970). "Realization of Partially Defined Logical Functions by Means of Expanding into Orthogonal Series", Automat. and Remote Control, vol. 32, N 8, p. 1278-1288.

"Utilization of Auto-correlation Functions for Realization of Systems of Logical Functions, Automat. and Remote Control, vol 31, N 2, p. 243-255.

Edwards, C.R. (1975). "The Application of Rademacher-Walsh Transform to Boolean Functions Classification and Threshold Logic", IEEE Trans Comp. C-24, p. 468-472.

Besslich, Ph. W., Pichlbauer. (1981). "A Fast Transform Procedure for the Generation of Near Minimal Covers of Boolean Functions", ProcIEEE vol 128, Part E, p. 250-254.

Besslich, Ph. W. (1978). "On the Walsh-Hadamard Transform and Prime Implicant Extraction", IEEE Trans on Electromagnetic Compatibility, vol EMC-20, p. 516-519.

Harmuth, H.F. (1972). "Transmission of Information by Orthogonal Functions", Springer, Berlin.

Rushforth, C.V. (1969). "Fast Fourier-Hadamard Decoding of Orthogonal Codes", Information and Control 15, p. 37-39.

Thompson, K.R., Rao, K.R. (1977). "Analyzing a Biorthogonal Information Channel by the Walsh-Hadamard Transform," Comput. and Electr. Eng., vol 4, No 2, p. 119-132.

Schreiber, H.H. (1976). "Communications with Walsh Waves," Proc. Int. Symp. on Electromagnetic Compatibility, p. 258-263.

Transforms for the Computation of Radiation Patterns of Aperture Antennas", Int. Symp Antennas and Propagation, p. 207-210.

. MacWilliams, F.J., Sloane, N.J.A. (1977). "The Theory of Error-Correcting Codes", North Holland, Amsterdam.

. Karpovsky, M.G. (1979). "On Weight Distribution for Binary Linear Codes", IEEE Trans on Inf. Theory, IT-25, p. 105-109.

. Karpovsky, M.G. (1981). "Weight Distribution of Translates, Covering Radius and Perfect Codes Correcting Errors of the Given Weights", IEEE Trans. on Inf. Theory, July 1981, p. 962-972.

1. Karpovsky, M.G. (1977). "Harmonic Analysis over Finite Commutative Groups in Linearization Problems for Systems of Logical Functions," Information and Control, vol 33, p. 142-165.

. Moraga, C. (1978). "Complex Spectral Logic", Proc. 8th Int. Symposium on Multiple-Valued Logic, p. 149-156.

2. Moraga, C. (1978). "Comments On A Method Of Karpovsky", Information and Control, vol 35, N 3, p. 243-246.

3. Karpovsky, M.G. (1981). "Spectral Methods of Decomposition Design and Testing of Multiple-valued Logical Networks", Keynote paper, Proc. of 11th Int. Symp on Multiple-valued Logic, p. 1-10, Oklahoma.

Spectra of Ternary Logic Functions", Proc 9th Int. Symposium on Multiple-Valued Logic.
Hurst, S.L. (1979). "An Engineering Consideration of Spectral Transforms For Ternary Logic Synthesis, "The Computer Journal, Vol. 2, No 2, p. 173-183.
Pichler, F. (1970). "Walsh Functions and Linear System Theory" Proc. Symp. and Workshop on Walsh Functions, NTIS AD 707431, p. 175-182.
Pratt, W.K. (1978). "Digital Image Processing," Wiley-Interscience.
Ahmed, N., Rao, K.R. (1975). "Orthogonal Transforms For Digital Signal Processing", Berlin-Heidelberg-New York, Springer.
Maqusi, M. (1981). "Applied Walsh Analysis", Heyden.
Pearl, J. (1975). "Optical Dyadic Models of Time-Invariant Systems," IEEE Trans. on Comp. , C-24, p. 598-603.
Siddiqi, M.U., Mullick, S.K., Reddy, B.R.K. (1983). "Data-Compression Based on Local Dependence Properties of the Haar Transform," Proc. Int. Workshop on Fault Detection and Spectral Techniques, Boston. p. 8.01-8.31.
Trachtenberg, E.A., Karpovsky, M.G. (1983). "Detection of Signals in Communication Channels by Fourier Transforms over Finite Groups", Proc. Int. Workshop on Fault Detection and Spectral Techniques, Boston, p. 9.1-9.15

Computation Technique", IEEE Trans. on Comp., C-21, p. 636-641.

4. Karpovsky, M.G. (1977). "Error detection in Digital Devices and Computer Programs by Linear Recurrent Equations over Finite Commutative Groups," IEEE Trans. on Comp., C-26,p. 103-219.

5. Karpovsky, M.G., Trachenberg, E.A. (1977). "Linear Checking Equations and Error Correcting Capability for Computation Channels", Proc 1977 IFIP Congress, North Holland, p. 619-624.

6. Karpovsky, M.G. (1979). "Error Detection for Polynomial Computations", IEE Journal on Computer and Digital Techniques, vol. 2, N 1, p. 49-57.

7. Karpovsky, M.G. (1980). "Testing for Numerical Computations", IEE Proc. vol. 127, N 2, p. 69-77.

8. Karpovsky, M.G. (1982) "Detection and Location of Errors by Linear Inequality Checks", IEE Proc vol 129, N 3, p. 86-92.

9. Karpovsky, M.G. (1982). "Testing for Multiple Valued Computations" Proc. 12th Int. Symp. on Multiple-Valued Logic.

50. Karpovsky, M.G. (1984). "Memory Testing by Linear Checks", IEE Proc. Vol. 131, No. 5, p. 158-168.

51. Susskind, A.K. (1981). "Testing by Verifying Walsh Coefficients", Proc. 11 Int. Symp. on Fault-Tolerant Computing, p. 206-204.

52. Muzio, J.C., Miller, D.M. (1982). "Spectral Techniques for Fault Detection", Proc. 12th Int. Symposium on Fault-Tolerant Computing, p. 297-302.

Signatures for Internally Unate Combinational Networks", IEEE Trans. on Comp., C-33.

Eris, E., Muzio, J. (1984). "Syndrome and Autocorrelation-Testable Internally Unate Combinational Networks", Electronic Letters, vol. 20, N 6, p. 264-266.

Karpovsky, M.G., Moskalev, E.S., Troiansvsky, A.A. (1974). "Estimations on Error-Correcting Capabilities of Logical Functions", Izvestia Acad Nauk USSR, vol 12, N 1, p. 155-162.

Karpovsky, M.G., Troianovsky, A.A. (1974). "Methods for Analyzing the Correcting Power of Automata", Automat. Control and Computer Science, vol 8, N 1, p. 22-27.

Redinbo, G.R. (1981). "Noise Analysis of Soft Errors in Combinational Digital Circuits", IEEE. Trans, EMC-23, p. 392-400.

Wang, G.X., Redinbo, G.R. (1984). "Probability of State Transition Errors in a Finite State Machine Containing Soft Failures," IEEE Trans on Comp., Vol. C-33.

Broussard, M.E. (1973). "Higher Yields, Lower Costs," Proc. Int. Symp. on Fault-Tolerant Computing, p. 6-11.

Bottorff, P.S. (1980). "Test Generation", Proc NATO Advanced Study Institute on Computer Design Aids for VLSI Circuits, (Italy) Section 5.

(1968). "Error Detecting Logic for Digital Computers", McGraw-Hill.

2. Roth, J.P. (1966). "Diagnosis of Automata Failures: A Calculus and A Method", IBM & Res. Develop., p. 278-281.

3. Eichelberger, E.B., Williams, T.W. (1978). "A Logic Design Structure for LSI Testability", J. Design Automat. Fault Tolerant Comput. Vol. 2, p. 165-178.

4. Thatte, S.M., Abraham, J.A. (1980). "Test Generation for Microprocessors", IEEE Trans. on Comp, vol. C-29, p. 423-441.

5. Abraham, J.A. (1981). "Functional Level Test Generation For Complex Digital Systems," IEEE Int. Test Conf., p. 461-462.

6. Goel, N., Karpovsky, M.G. (1982). "Functional Testing of Computer Hardware Based on Minimization of a Magnitude of Undetected Errors", IEE Proc. vol. 129, p. 169-181.

7. Karpovsky, M.G., Van Meter, R.J. (1984). An Algorithm for Testing of Microprocessors", Proc 1984 Design Automation Conference..

8. Abraham, J.A., Parker, K.D. (1981). Practical Microprocessor Testing: Open and Closed Loop Approaches", Proc. FTCS.

59. Karpovsky, M.G. (1982). "Universal Tests Detecting Input/Output Faults in Almost All Devices," Proc. Int. Test Conf., p. 52-57.

Detection of Input/Output Stuck-at and Bridging Faults," IEEE Trans on Computers, vol. C-32, p. 1194-1198.

Karpovsky, M.G., Levitin, L.B. (1983). "Detection and Identification of Input/Output Stuck at and Bridging Faults in Combinational and Sequential VLSI Networks by Universal Tests", Integration, the VLSI Journal, p. 22-44.

Karpovsky, M.G., Levitin, L.B. (1983). "A New Probabilistic Approach to VLSI Testing", Proc Int Workshop on Fault Detection and Spectral Techniques, Boston. p. 3.1-3.34.

Savir, J. (1980). "Syndrome Testable Design of Combinational Circuits", IEEE Trans. on Comp., vol. C-23, p. 442-451.

Barzilai, Z., Savir, J., Markovsky, M., Smith, M.G. (1981). "VLSI Self-Testing Based on Syndrome Techniques", IEEE Int. Test. Conf, p. 102-109.

Chandra, A.K., Kou, J.T., Markowsky, M., Zaks, S. (1981). "On Sets of Boolean n-Vectors With All K-Projections Surjective", IBM Res., Report, RC 8936.

Barzilai, Z., Coppersmith, D., Rosenberg, A.Z. (1983). "Exhaustive Generation of Bit Patterns with Application to VLSI self-testing", IEEE Trans on Comp., vol. C-32, p. 190-194.

Pattern Generation Using Linear Codes", *IBM Res. Report* RC-9722.
8. G. Cohen, M.G. Karpovsky, L.B. Levitin. (1984). "Exhaustive Testing of Combinational Devices with Outputs Depending on a Limited Number of Inputs", 1984 *IEEE Information Theory Workshop*.
9. Smith, J.E. (1980). "Measures of Effectiveness of Fault Signature Analysis", *IEEE Trans on Comp.*, vol. C-29, p. 510-514.
0. Sridhar, T., Ho, D.S., Powel, T.J., Thatte, S.M. (1982). "Analysis and Simulation of Parallel Signature Analyzers", *IEEE Int. Test Conf.*, p. 656-661.
1. Hayes, J.P. (1978). "Generation of Optimal Transition Tests", *IEEE Trans. on Comp.*, vol C-27, p. 36-41.
2. Karpovsky, M.G., Tcherbakov, N.S. (1974). "Automata with Transition Self-Correction", *Cybernetics*, vol. 7, p. 1011-1015.
3. Breuer, M.A., Friedman, A.D. (1976). *"Diagnosis and Reliable Design of Digital Systems"*, Computer Sci. Press.
4. Saluja, K.K., Karpovsky, M.G. (1983). "Testing Computer Hardware Through Data Compression in Space and Time", *Proc. Int. Test Conf.*
5. Sedmak, R.M., Libergot, H.L. (1980). "Fault Tolerance of a General Purpose Computer Implemented by Very Large Scale Integrating", *IEEE Trans. Compv.* C-29, p. 492-500.

Sequential Machines Using Past Information", IEEE Trans on Computers, C-20, p. 392-396.

Siewiorek, D.P., Swarz, R.S. (1982). "The Theory and Practice of Reliable System Design", Digital Press.

Avizienis, A. (1978). "Fault-Tolerance: The Survival Attribute of Digital Systems", Proc of the IEEE, vol 66, p. 1109-1125.

Tryon, J.G. (1962). "Quadded Logic", in Wilcox and W.C. Mann eds. Redundancy Techniques for Computing Systems, Washington, D.C., Spartan Books, p. 205-228.

Jensen, P.A. (1963). "Quadded NOR Logic", IEEE Trans on Reliability, R-12, No 3, p. 22-31.

Freeman, H.A., Metze, G. (1972). "Fault Tolerant Computers Using 'Dotted Logic' Redundancy Techniques", IEEE Trans. Comp., C-21, p. 867-871.

Pierce, W.H. (1965). "Failure Tolerant Design", New York, Academic Press.

Pradhan, D.C., Reddy, S.M. (1974). "Design of Two-Level Fault-Tolerant Networks", IEEE Trans. Comp. C-23, p. 41-47.

Meyer, J.F. (1971). "Fault Tolerant Sequential Machines", IEEE Trans. Comp. C-20, p. 1167-1177.

Larsen, R.W., Reed, I.S. (1972). "Redundancy by Coding versus Redundancy by Replication of Failure-Tolerant Sequential Circuits", IEEE Trans. Comp. C-21, p. 130-137.

Applying Error Correction to Synchronous Digital Systems," Bell System Tech. Journal 40, p. 577-593.

7. Karpovsky, M.G., Karpov, Yu. G. (1973). "The Optimal Code Redundancy Methods for Error Correction in the Finite Automata", Cybernetics, p. 82-88.

8. Karpovsky, M.G. (1971). "Error Correction in Automata with Combinational Blocks Realized by Expansion in Orthogonal Series", Automat. and Remote Control, vol 32, N 93, part 2, p. 1524-1528.

9. Karpovsky, M.G., Karpov, Yu. G. (1975). "Decomposition of Algebras and Synthesis of Reliable Discrete Devices By Intergral Modulii, Cybernetics, vol 9, N 3. 100.

0. Toy, W.N. (1978). "Fault-Tolerant Design of Local ESS Processors", Proc. of IEEE, Vol. 66, No. 10, p.1126-1145.

1. Pradhan, D.K., Stiffler, J.J. (1980). "Error-Correcting Codes and Self-Checking. Circuits", Computer 13, No 3, p. 27-37.

2. Pradhan, D.K. (1980). "A New Class of Error-Correcting/Detecting Codes for Fault-Tolerant Computer Applications", IEEE Trans Comp., C-29, p. 471-481.

3. Redinbo, G.R. (1983). "The Design and Analysis of High-Speed Logic Systems with Distributed Error Correction", Int. Workshop on Fault Detection and Spectral Techniques, Boston, p. 11.1-11.21.

to Fault-Tolerant Logic", Journal of Information Processing, vol. 3, N 3, p. 120-126.

Mei, K.C.Y. (1974). "Bridging and Stuck-at Faults", IEEE Trans. on Comp., C-23, p. 720-727.

Iosupovicz, A. (1978). "Optimal Detection of Bridging Faults and Stuck-at Faults in Two-Level Logic", IEEE Trans. on Comp., C-27, p. 452-455.

Karpovsky, M.G., Su, S. (1980). "Detection and Location of Input and Feedback Bridging Faults, "IEEE Trans on Computers, C-26, N 6, p. 523-528.

Karpovsky, M.G., Su, S. (1980). "Detection of Bridging and Stuck-at Faults at Input and Output Pins of Standard Computer Components", Proc. 17th Design automation Conference, p. 494-506.

Hayes, J.P. (1975). "Detection of Pattern-Sensitive Faults in Random Access Memories", IEEE Trans. on Comp., C-24, p. 150-157.

Timoc, C., Buchler, M., Griswold, T., Pine, C., Scott, F. Mess, L. (1983). "Logical Models of Physical Faults", Proc. 1983 Int. Test Conf., p. 546-553.

El-Ziq, Y.M. (1981). "Automatic Test Generation for Stuck-Open Faults in CMOS VLSI", Proc. The 18th Design Automation Conf., p. 347-354.

Chandramouli, R. (1983). "On Testing Stuck-Open Faults", Proc. 1983 Int. Symp. on Fault-Tolerant Computing.

DeSousa, P.T., Mahtur, F.P. (1978). "Sift-Out Modular Redundancy", IEEE Trans. Comp., C-27, p. 624-627.

Scheme; Self-Purging Redundancy", IEEE Trans. Comp., C-25, p. 569-578.

15. Bennetts, R.G. (1984). "Design of Testable Logic Circuits", Addison Wesley.

16. Roth, J.P. (1980). "Computer Logic, Testing and Verification, Computer Science Press.

17. Aizenberg, N.N., Ivaskiv, Yu L. (1975). "Group Properties of Tests Used in Problems of Diagnosis, Reliability and Monitoring", Cybernetics, vol 115, pp 839-840.

18. Gongli, Z. (1984). "Two Complete Orthogonal Sets of Real Multiple-Valued Functions", Proc. 14th Int. Symposium on Multiple-Valued Logic, p. 12-18.

19. Stankovic, R.S., Moraga, C. (1984). "Fast Algorithms for Detecting Some Properties of Multiple-Valued Functions", Proc. 14th Int. Symposium on Multiple-Valued Logic, p. 8-52.

20. Redinbo, G.R., Wang, G.X. (1983). The Probability of Error in Combinational Logical Systems Containing Soft Fails", IEE Proc. Computers and Digital Techniques, vol. 13, No 4.

21. Reddy, S.M., Saluja, K.K., Karpovsky, M.G. (1985). "A Data Compression Technique for Built-in Self Test", submitted to 15th Fault-Tolerant Computing Symposium.

22. Trachenberg, E.A. (1979). "Fast Wiener Filtering Computation Techniques," Proc 1978 Int. Symp. on the Mathematical Theory of Networks and Systems, vol 3, Delf Holland, p. 174-179.

Groups as Suboptimal Filters: A Comparative Study", _Proc. 1983 Int. Symp. on Math. Theory of Networks and Systems_, Beer-Sheva, Israel.

Lechner, R.J. (1962). "Transformations Among Switching Functions Canonical Forms", _IEEE Trans on Electronic Computers_, EC-12 (2).

Karpovsky, M.G., Trachtenberg, E.A. (1985). "Fast Techniques for Signal Detection in Noisy Communication Channels", _IEEE Trans on Information Theory_ (accepted for publication).

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Abramson, R.F. "Sinc and Cosinc Transform", IEEE Trans. Electromagn. Compat., EMC-19, n 2, p.88-94.

Adams, E.R. (1981). "Analysis of Multivariate Non-Stationary Signals", IEE Colloquium (Digest), Publ by IEE, London, Eng. p 7.

Agaian, S.S. (1980). "Algorithms of Orthogonal Matrices Fast Transform", Progress in Cybernetics and Systems Research, Vol. 8; General Systems Method., Mathe. Systems Theory, Fuzzy Sets. (Part of the proceedings of the 5th European Mtg. on Cybernetics and Syst. Res.) Vienna, Aus.

Ahmed, N., Rao, K.R. (1971). "Generalized Transform", IEEE Electromagn. Compat. 13-15, Washington, DC, Publ. NTIS, Springfield, VA, USA.

Ahmed, N., Rao, K.R. (1971). "Transform Properties of Walsh Functions", Proceed. of the IEEE Fall Elect. Conf. p. 378-82. Chicago.

This bibliography was compiled with the support from the Digital Equipment Corporation, Maynard, MA, USA.

ISBN 0-12-400060-6

6. Ahmed, N., Abdussattar, L., Rao, K.R. (1972). "On an Analogy Between the Fourier and Walsh Hadamard", Proceedings of the National Elect. Conf. Vol. XXVII, p. 383-7, Chic., Ill.

7. Ahmed, N. (1972). "Some Considerations of the Discrete Fourier and Walsh-Hadamard Transforms", Proceedings of the 1972 IEEE Conf. on Decision Control and 11th Symp. on Adaptive Processes, p.495-498.

8. Ahmed, N., Natarajan, T., Rao, K.R., (1973). "Some Considerations of the Haar and Modified Walsh-Hadamard Transforms", Appl. of Walsh Funct., Symp, 4, p. 91-95.

9. Ahmed, N., Schreiber, H.H., Heinz, H., Lopresti, P.V. (1973). "On Notation and Definition of Terms Related to a Class of Complete Orthogonal Functions", IEEE Trans. Electro. Compat., EMC-15, n2, p. 75-80.

10. Ahmed, N., Natarajan, T., Rao, K.R. (1973). "Cooley-Tukey-Type Algorithm for the Haar Transform", Electron Lett, v 9, n 12, p. 276-278.

11. Ahmed, N., Rao, K. R., Abdussattar, A.L. (1973). "On Cyclic Autocorrelation and the Walsh-Hadamard Transform", IEEE Trans. Electromagn. Compat., EMC-15, n 3, p. 141-146.

12. Ahmed, N., Natarajan, T., Rao, K.R. (1974). "Discrete Cosine Transform", IEEE Trans., Electromagn. Compat, p. 90-93.

13. Ahmed, N., Natarajan, T., Rao, K.R. (1975). "Orthogonal Transforms for Digital Signal Processing", Springer, NY.

Spectrograms", IEEE Trans. Electro. Compat., EMC-18, n 4, p. 198-200.

Ahmed, N. (1980). "Walsh Functions: Some Properties and Applications", IEEE Int. Symp. on Electromagnetic Compat., p. 275-81.

Aizenberg, N.N., Ivas´kiv. Yu.L. (1975). "Group Properties of Tests Used in Problems of Diagnosis, Reliability, and Monitoring", Trans. in Cybernetics, v 11, n 5, p.839-40.

Aizenberg, N.N., Rud´ko, V.P. (1975). "Haar Functions and Discrete Transformation", Tekh. Kibern. (USSR), v 13, n 6, p.86-95.

Alexandridis, N.A. (1971). "Walsh-Hadamard Transformations in Image Processing", UCLA-ENG-7208, AFOSR-TR-71-1362, p.133.

Andrews, H.C., Caspari, K.L. (1969). "A Generalized Technique for Spectral Analysis", IEEE Trans. Comp. C-19.

Andrews, H.C., Caspari, K.L. (1971). "Degrees of Freedom and Modular Structure in Matrix Multiplication", IEEE Trans. Comput., C-20, p. 133-41.

Andrews, H.C. (1971). "Walsh Fuctions in Image Processing, Feature Selection and Pattern Recognition", IEEE Electro. Compat., EMC-13, n3, p.26-32.

Andrews, H.C. (1972). "Some Unitary Transformations in Pattern Recognition and Image Processing", Proceedings of the IFIP Congress 1971, v 1, p. 155-60.

Andrews, H. C. (1972). "Walsh Fuctions From the Perspective of Useful Unitary Transformations for Data Processing", IEEE Conf., p. 492-4.

24. Andrews, H., Kung. W., Tasche, M. (1981). "Some Applications of the W-Transformation and Moore-Penrose Inverses to the Theory of Finite Systems", Z. Electr. Inf. and Energietech, v 11, n5, p. 385-98.

25. Antoniak, C.E. "Distribution-Free Filter", Report No.: PAT-APPL-617 886; PATENT-4 012 627.

26. Artem´Yev, M.Yu, Gayev, G.P., Krenkel´, T.E., Skotnikov, A.P. (1978). "An Algorithm for Forming Symmetric Systems of Walsh Functions", Radiotekh. & Elektron. (USSR), v 23, n7, p.1432-30.

27. Ashour, M.R., Constantinides, A.G. (1977). "Pipeline Fast Walsh-Fourier Transform", IEEE Int. Conf. on Acoust., p.515-518.

28. Bai, J.B., Barba, J., Scheinberg, N., Schilling, D.L. (1983). "Walsh Transform Coding of NTSC Composite Color Signals", IEEE Serv Cent., NJ, p. 83-89.

29. Bailey, J.M., Tillman, J.D. (1980). "Applications of Walsh Transforms to Linear Systems", Proc. SOUTHEASTCON Reg 3 Conf.

30. Bailey, J.M., Tillman, J.D. (1980). IEEE Comput Soc., Los Alamitos, CA., p. 60-63.

31. Bansod, P. N., Kitai, R. (1976). "Microprocessor Application In Walsh Fourier Spectral Conversion", IEEE Int. Symp. on Electro. Compat., p.272-7.

32. Barnett, S. (1981). "Comment on A Useful Property of the Coefficients of a Walsh-Hadamard Transform", IEEE Trans. Acoust., ASSP-29, #6, p.1202.

33. Bass E.C. (1970). "Proceeding of Applicaitons of Walsh Functions", Symposium and Workshop Mar31-Apr3, 1970. Naval Research Lab., Wash. DC, p.274.

Functions)", Funkschau (Ger) #9, p.83-6.
Beauchamp, K.G., Williamson, M. E. (1973). "Digital Filtering for Signal Analysis Using Fourier and Walsh Techniques", Conf. on the Use of Digital Computers in Measurement, IEEE, London, Eng., v 1, p. 172.
Beauchamp, K.G. (1975). "Walsh Functions and Their Applications", Academic Press.
Beer, T. (1981). "Walsh Transforms", AM.J.Phys. v 49, n5, p. 466-72.
Bekmuratov, T.F., Musaev, M.M. (1973). "Design Method for a Digital-Analogue Funtional Converter for Two Arguments", Avtometriya (USSR), n3, p.121-125.
Bennetts, R.G., Hurst, S.L. (1978). "Rademacher-Walsh Spectral Transform: A New Tool For Problems in Digital-Network Fault Diagnosis", IEE J.Comput. and Digital Tech., v 1, n2, p.38-44.
Berauer, G. (1975). "A Generalization of Discrete Walsh Functions", Electrom. Compatibility 1975 543 20-22, Switzerland:IEEE, XII, p.549.
Besslich, P.W. (1973). "Walsh Function Generators for Minimum Orthogonality Error", IEEE Trans Electromagn Compat., EMC-15, n 4, p.177-180.
Besslich, P.W. (1974). "Sequential Circuits and Walsh Functions", Nachrichtentech. A. (NTZ) (Ger), v 27, n4, p. 154-7.
Besslich, Ph.W. (1978). "Determination of the Irredundant Forms of Boolean Functions Using Walsh-Hadamard Analysis and Dyadic Groups", IEEE Journal on Computers and Digital Techniques, p.143-151.

44. Besslich, Ph.W. (1978). "On the Walsh-Hadamard Transformaand Prime Implicant Extraction", IEEE Trans Electromagn. Compat., EMC-20, p.516-519.
45. Besslich, Ph. W., Pichlbauer, P. (1981). "A Fast Transform Procedure for Generation of Near Optimal Covers of Boolean Functions", Proc. IEE, v. 128, part E, p 250-254.
46. Besslich, Ph. W. (1983). "A Method for the Generating and Processing of Dyadic Indexed Data", IEEE Trans. Comput., C-32, pp 487-494.
47. Besslich, Ph.W. (1983). "On Radix-2 Similarity Transformations Based on the Two-Dimensional WHT", Proc. IEEE Symp. on Electromagn. Compat.
48. Bied-Charreton,P., Coiffard, J.M., Sokoloff, B.A. (1973). "Introduction to the Walsh Transform and Some Applications", Rev. Tech. Thomson-CSF (FR), V 4, p.729-60.
49. Blachman, N.M. (1971). "Spectral Analysis with Sinusoids and Walsh Functions", IEEE Trans. Aerosp, Electron Syst, AES-7, n 5, p.900-5.
50. Blachman, N.M. (1972). "Some Comments Concerning Walsh Functions", IEEE Trans. Inf. Theory IT-18, p.427-8.
51. Blachman, N.M. (1974). "Sinusoids VS. Walsh Functions", Proc IEEE, v 62, p.346-354.
52. Blaesser, L. (1983). "Spectral Analysis of Stochastic Signals Using Walsh Transform", Proc. 9th Imeko Cong. of the Int. Measurement Confed. 197-206, v 3, p.24-28.
53. Blyumin, S.L., Shmyrin, A.M. (1974). "Sequency of Walsh Functions and Their Generalizations", Probl. Inf. Transm. (USA), v 10, n3, p.275-6.25.

and Generalizations of Walsh Functions", Sov. Math. (USA), v 21, n2, p. 4-6.
Boerner, H. (1974). "Walsh Functions and Their Application", Nachrichtentech Elektron, v 24, n7, p.242-247.
Boeswetter, C. (1970). "Walsh Function Generation", Nachrichtentech. Z. (Ger), v23, n4, p.201-7.
Boeswetter, C. (1971). The Properties of Sequency Analysis and Synthesis of Signals", Nachrichtentechnische Zeit, v 24, p. 193-201.
Boeswetter, C. (1971). "Mutual Spectral Representation of Trigonometric Functions and Walsh Functions", IEEE Trans. Electromagn. Compat., EMC-13, n 3, p. 43-6.
Boeswetter, C. (1971). "Signal Analysis and Synthesis by Means of Walsh Funtions", FREQUENZ (Ger.), v 25, n2, p.37-46.
Bohn, E.V. (1982). "Estimation of Continuous-Time Linear System Parameters From Periodic Data", Automatica, v 18, p. 27-36.
Bohn, E.V. (1983). "Recursive Expressions for Evaluating Walsh Coefficients for Linear Dynamic Systems", Int J Syst Sc, v 14, p. 673-682.
Bois, P. (1972). "Sequential Analysis", Geophys. Prospct. (Nether.), v 20, n3, p.497-513.
Bol´Shakov, I.A., Bokoshirs, U.S. (1977). "Application of Orthogonal Systems of Discrete Functions to Microprocessor Processing of Signals", Engrg. Cybernet., 1977, 15, n5, p.85-98.
Borner, H. (1974). "Walsh Functions and Their Applications", Nachrichtentech Elektron (Ger), v24, n7, p.242-7.

65. Bowyer, C.E. (1971). "Walsh Functions,Hadamard Matrices and Data Compression", Naval Res. Lab.; IEEE; Proceedings of the 1971 Symp. on Applications of Walsh Functions, p.33-7.

66. Bracha, E. (1977). "Walshstore: The Application of Burst Processing to Fail-Soft Storage Systems Using Walsh Transforms", Rep. #UIUCDCS-R-77-878; UILU-ENG-77-1753, p.80.

67. Bramhall, J.N. (1973). "First Fifty Years of Walsh Functions", Appl of Walsh Funct. Symp. 4th Proc. CUA, Washington D.C., p.41-60.

68. Bramhall, J.N. (1974). "An Annotated Bibliography on Walsh and Walsh Related Functions", Naval Ord. System. Com., Arlington VA. Report #APL-TG-1198B, p. 341.

69. Breuer, M.A., Friedman, A.D., Hayes, J.P. (1976). "System Testing and Design For Diagnosability", USCAL Sci. Lab. p. 17.

70. Britton, R.L. (1975). "Communication Structure to Implement a Multi-Microprocessor Computer Architecture", IEEE 1975 Reg 6 - West USA Conf. Proc. SLC, Utah, p.81-84.

71. Brown, C.G. (1970). "Walsh Functions and Signal Processing", IEEE Proc. Nat. Aerosp. Electron Conf., p.397-404.

72. Brown, C.G. (1970). "Signal Processing Techniques using Walsh functions", Proc. Appli of Walsh Functions. Symp & Workshop, Washington, DC, p.138-46.

Sequency Ordered Fast Waslh Transform", IEEE Trans. Comput., C-26, n8 p. 819-820.
Brugia,O.,Poscetti, G.M., Roveri, A. (1974). "On Some Properites of Hadamard Transforms", ALTA Freq (Italy), v 43, n8, p.523-46.
Brugia, O., Wolfowicz, W. (1981). "Representation of Walsh Discrete functions of The Input-Output Equation for Pseudolinear Systems", NASA, #FUB-3-1981, p.5.
Buston, A.T. (1962). "Generalized Hadamrd Matrices", Proc American Math Society 13, p. 894-898.
Butin, H. (1972). "Compact Definition of Walsh Function", IEEE Trans. Comput., C-21, n 6, p. 590-592.
Butin, H. (1978). "On an Ordering of Walsh Functions", IEEE Trans. Comput. C-27, n1, p.87-90.
Butzer, P.L., Wagner, H.J. (1972). "On a Gibbs-Type Derivative in Walsh-Fourier Analysis with Applications", Proc. of the NEC VXXVII, p.393-8.
Butzer, P.L., Wagner, H.J. (1973). "Calculus for Walsh Functions Defined on R", Appl of Walsh Funct. Symp. 4th, Proc. CUA, Washington, DC, p. 75-81.
Butzer, P.L., Wagner, H.J. (1973). "Walsh-Fourier Series and the Concept of a Derivative", Appl. Anal., v 3, n 1, p. 29-46.
Butzer, P.L., Wagner, H.J. (1975). "On the Role of Walsh and Haar Functions in Dyadic Analysis", Electro. Compat. p. 542.

83. Butzer, P.L., Engels, W. (1982). "Dyadic Calculus and Sampling Theorems for Functions with Mulitdimensionsal Domain. I. General Theory", Inf. & Control (USA), v 52, n3, p.331-51.

84. Cairns, T.W. (1971). "On the Fast Fourier Transform on Finite Abelian Groups", IEEE Trans. Comput., C-20, n 5, p.569-71.

85. Cardot, C. (1972). "Simple Analytical Definition of Walsh Functions and Application to the Exact Determination of their Spectral Properties", Ann. Telecommun. (FR), v27, n1-2, p.31-47.

86. Carl, J.W., Hall, C.F. (1972). "The Application of Filtered Transforms to The General Classfication Problem", IEEE Trans. Comp., C-21, n7, p.785-790.

87. Carl, J.W., Swartwood, R.V. (1975). "A Hybrid Walsh Transform Computer", IEEE Trans. on Comp., C-22, n7, p.669-672.

88. Carl, J.W. (1975). "Special Purpose Computer to Implement Kronecker-Matrix Transformation", Pat-Appl-366 915: Patent-3 879 605 Filed 4th.

89. Carrigan, B. (1980). "Walsh Function (A Bibliography with Abstracts)", NTIS, p.114.

90. Chaiko, K.I. (1980). "Use of Walsh Functions For Data Transmission over Channels with Short-term Interrruptions", Telecommun Radio Enf, v 34-35, n 1, p.79-83.

91. Chakravarthy, C.R. (1972). "Applications of Walsh Functions For Multiplex Communication Systems", Electro-Technol. (India), v 16, n2, p. 94-102.

Multiplexing", IEEE Int Symp Electro Compat, Baltimore, MD, p. 349-353.

Chen, C.F., Hsiao, C.H. (1974). "Walsh Series Analysis in Optimal Control", 8th Asilomar Conf., p.207-12.

Chen. C.F., Hsiao, C.H. (1975). "Time-Domain Synthesis Via Walsh Functions", Proc. Inst. Electr. Eng (Lond), v 122, n 5, p. 565-570.

Chen, C.F., Hsiao, C.H. (1975). "State-Space Approach to Walsh Series Solution of Linear Systems", Int J Syst Sci, v6, n9, p. 833-858.

Chen. C.H. (1975). "Theory and Applications of Image Pattern Recognition". AF Off. Sci. Res. Arlington, VA. Rep #EE-75-3; AFOSR-TR-0795, p.81.

Chen, P., Seemuller., W.W. (1980). "Detection of Signal Signatures of Cartographic Features", Army Eng. Topographic Labs, VA, p.15.

Chen, W. H. (1973). "Slant Transform Image Coding", Rep. #USCEE-441, p.181.

Chen, W. L., Shih, Y. P. (1978). "Parameter Estimation of Bilinear Systems Via Walsh Functions", J Franklin Inst., v 305, n 5, p. 249-257.

Chen, W.L., Shih, Yen-Ping. (1978). "Analysis and Optimal Control of Time-Varying Linear Sytems", Int J Control, v 27, n6, p. 917-932.

Chen, W.L., Shih, Y.P. (1978). "Shift Walsh Matrix and Delay -Differential Equations", IEEE Trans. Autom. Control, AC-23, n6, p.1023-1028.

103. Chen, W.L., Lee, C.L. (1982). "Walsh Series Expansion of Composite Functions and its Application to Linear Systems", Intern. J Syst. Sci., p. 219-226.

104. Chen, W.M., Smith, C.M., Fralick, S.C. (1977). "A Fast Cmputational Algorithm for the Discrete Cosine Transform", IEEE Trans On Comm., COM-25, p. 1004-1009.

105. Chen, Y.B. (1983). "Analysis and Synthesis of Linear Dynamic System Via Walsh Functions", IEEE 1983 Int. Symp. on Elect. Compat. Symp. Rec. USA, p.2983.

106. Cheng, D.K., Liu, J.J. (1973). "Walsh Transform Analysis of Discrete Linear Systems", Appl of Walsh Funct., Symp. 4th Proc. CU of Am, Washington, DC, p. 61-65.

107. Cheng, D.K., Liu, J.J. (1974). "Walsh-Transform Analysis of Discrete Dyadic-Invariant Systems", IEEE Trans. Electromagn Compat. EMC-16, n2, p. 136-139.

108. Cheng, D.K. (1974). "Characteristics and Capabilities of Walsh Functions", Rep. #AFOSR-TR-74-1439, p.35.

109. Cheng, D.K., Liu, J.J. (1975). "Paley, Hadamard, and Walsh Functions: Interrelationships and Transconversions", AFSOR-TR-0812, p.24.

110. Cheng, D.K., Liu, J.J. (1976). "Time-Shift Theorems for Walsh Transforms and Solution of Difference Equations", IEEE Trans Electromagn Compat., EMC-18, n2, p. 83-87.

Sequency Ordering of Hadamard Functions", IEEE Trans. Comput., C-26, n3, p.308-9.
. Cheng, D.K. (1977). "New Capabilities of Walsh Functions and Walsh Transforms", Rep. #AFOSR-TR-77-0802, p.5.
. Cheng, D.K. (1979). "Theory and Applications of Generalized Walsh Functions in Digital Systems", AFOST-TR-0916, p.30.
. Cheng, D.K., Shankar, A.U. (1979). "Error Analysis of Multiple-Output Combinational Circuits in a Noisy Environment", IEE J Comput Digital Tech., v 2, n4, p. 145-150.
. Chien, Ta-Mu. (1975). "On Representations of Walsh Functions", IEEE Trans Electromagn. Compat., EMC-17, n3, p.170-176.
. Chien, Y.T. (1980). "Distributed Computing in Pattern Recognition With Applications to Image Processing", Proc of Int. Conf. on Cybernetics & Society , p.1140.
. Choras, R.S. (1976). "Walsh Function Generator", Pomiary Autom. Kontrola (Poland), v 22, n7, p. 248-251.
. Choras, R.S. (1978). "Use of Hadamard, Haar and Hadamard-Haar Linear Transformations for Image Coding", Arch. Autom. & Telemech. (Poland), v23, n1-2, p. 141-57, 1978.
. Choras, R.S. (1983). "Application of Hadamard, Haar, and Hadamard-Haar Transformation to Imag Coding and Bandwidth Compression", Proc. of SPIE Int. Soc. Opt. Eng., v359, p.336-342.

120. Chow, D., McDonald, J, King, D., Smith, W., Molnar, K., Steckl, A. (1983). "Image Processing Approach to Fast Efficient Proximity Correction for Electron Beam lithography", Journal of Vacuum Sci & Tech, v1, n4, p. 1383-1390.

121. Chrestenson, H.E. (1955). "A Class of Gerealized Walsh Functions", Pacific Jr. Math. 5, p. 17-31.

122. Chung-Kwong, Y. (1972). "Remarks on the Ordering of Walsh Functions", IEEE Trans. Comput., C-21, n12, p.1452.

123. Chung-Kwong, Y. (1975). "An Algorithm for Computing the Correlation Functions of Walsh Functions", IEEE Trans. Electromagn. Compat., EMC-17, n3, p.177-180.

124. Chung-Kwong, Y. (1977). "Testing Random Number Genrators by Walsh Transform", IEEE Trans. Comput., C-26, n4, p. 329-33.

125. Claire, E.J., Farber, S.M., Green, R.R. (1971). "Practical Techniques for Transform Data compression/Image Coding", Proc. of Symp. on Applic. of Walsh Functions 2-6, p.13-15.

126. Cohen, J.R. (1973). "Pragmatic View of Walsh Functions Through the Fourier Series", Appl. of Walsh Funct. Symp., 4th, p.257-258.

127. Cohen, M. (1971). "Walsh Functions, Sequency, and Gray Codes", Siam J. Appl. Mat., v21, n3, p.442-7.

128. Cohn-Sfetcu, S., Nichols, S. (1975). "On the Identification of Linear Dyadic Invariant Systems", IEEE Trans. Electromagn. Compat., EMS-17, n2, p.11-17.

Differential Calulus and Filtering in Galois Fields", IEEE Int. Conf. on Acoust., Speech & Signal Proc. Assoc, p. 12-14.

. Cooper, J.A. (1977). "Orthogonal Transformation s of Digital Data", Digital Sign. Proc. Symp., p.14.

. Corinthios, M., Fortier, M. Prussel, M, Geadah, Y. (1976). "A Floating Point Computer for Generalized Spectral Analysis", IEEE, Proc., p. 31-6.

. Corinthios, M., Smith, K.C., Yen, J.L. (1975). "A Radix-4 Fourier Transform Computer", IEEE Trans. Comput., C-24,n1,p.80-92.

. Crestenson, H.E. (1955). "A Class of Generalized Walsh Functions", Pacific Jr. Math, v.5, p 17-31.

. Crittenden, R.B. (1973). "On Hadamard Matrices and Complete Orthonormal Systems", Appl. of Walsh Funct. Symp. 4th, Proc., p.82-84.

. D´Alton, L.B. (1980). "Rademacher-Walsh Diagnosis", Electron Eng. (GB), v 52, n643,83,85,87.

. Davidson, I.A. (1970). "Use of Walsh Functions for Multiplexing Signals:, Proc Applic. of Walsh Functins Symp & Workshop, Mar 31 - Apr 3, p.23-25.

. Davies, A.C. (1972). "On the Definition and Generation of Walsh Functions", IEEE Trans. Comput., C-21, p.187-9.

. Davio, M. (1981). "Kronecker Products and Shuffle Algebra", IEEE Trans. Comput., C-30, v.2, pp. 116-125.

139. Debowski, A. (1982). "Application of Walsh Function to identifiction Problem of Single-Dimension Linear Systems", Politech. Lodz, Electr. (Poland), n72, p.19-29.

140. De. M., Hazra, L.N. (1977). "Walsh Functions in Problems of Optical Imagery", Opt. Acta (GB), v 24, n3,p.221-34.

141. Des M., Hazra, L.N. (1977). "Real-Time Image Restoration Through Walsh Filtering", Opt. Acta (GB), v 24, n3, p.211-20.

142. De, M. (1980). "Walsh-Hadamard-Haar Hybrid Transforms", IEEE, vk XLVI+1382, p.1-4.

143. Dillard, G.M. (1980). "A Walsh-like Transform Requiring only Additions, with Applications to Data Compression", IEEE Proc.,p.101-105.

144. Dobesch, H. (1971). "On the Formation Laws of Walshs Functions", Tech. Mitt. RFZ (Germ), v 15, n2.

145. Dobesch, H. (1972). "Walsh Functions in Communication Engineering", Tech. Mitt. RFZ (Germ), v 16, n2, p.43-6.

146. Dromey, R.G. (1973). "Fast Walsh Transform Subroutine", Decuscope, v 12, n3, p.5-6.

147. Dunklee, A.L. (1973). "Use of Walsh Transforms in Image Processing", 4th Proc. Cathol. U. of America, p. 162-167.

148. Durgan, B.K., Lai, D.C. (1980). "Microprocessor Implemented Fast Walsh Transform", IEEE 1980,6th IECI Annu Conf Proc, p.395-399.

"Sequential Generation of Binary Orthogonal Functions", Electron. Lett. (GB), v7, n13, p.377-80.

Durrani, T.S., Stafford, E.M. (1972). "Hardware Applications of Walsh Functions", Int J. Electron, v 33, n1, p. 53-65.

Dwolatzky, B. (1980). "Intermediate Domain System Identification Using Walsh Transforms", IEEE Int Symp. Electro. Compat., p. 371-375.

Edwards, C.R. (1975). "Application of the Rademacher-Walsh Transoform to Boolean Function Classification and Threshold Logic Synthesis", IEEE Trans. Comput., C-24, n1, p. 48-71.

Edwards, C.R. (1975). "Characterisation of Threshold Functions Under the Walsh Transform and Linear Translation", Electron. Lett. (GB), v 11, n23, p. 563-5.

Edwards, C.R. (1978). "A Special Class of Universal Logic Gates (ULG) and their Evaluation Under the Walsh Transform",Int. J. Electron (GB), v 44, n1, p. 49-59.

Elliot, A.R. (1971). "A Programmable Walsh Function Generator". IEEE Proc., p 168.

Elliott, D.F. (1974). "Class of Generalized Continuous Orthogonal Transforms", IEEE Trans., ASSP-22, n4, p 245-254.

Engels, W., Splettstoesser, W. (1982). "On Walsh Differentiable Dyadically Stationary Random Processes", IEEE Trans. Inf. Theory, IT-28, n4, p. 612-619.

158. Enomoto, H., Shibata, L. (1971). "Orthogonal Transform Coding System for Television Signals", Proc. of Symp. on Applications of Walsh Functions 11-17, 1X-128 pp.

159. Eris, E. (1978). "Relationships between Rademacher-Walsh Spectra of Boolean Functions", IEE J. Comput. Digital Tech., v 1, n2, p 45-48.

160. Fenwick, D., Steel, R., Vasanji, N. (1977). "Error Detection and correction of DPCM Video Signals Using a Walsh Hadamard Transform Technique", IEEE Conf. Proc., n37, p 255-268.

161. Ferjancic-Stiglic, D. (1975). "Walsh Functions - An Introduction to Theory and Applications", Automatika (Yugo), v 16, n3-4, 141-5.

162. Fernandez, L.C., Rao, K. (1977). "Design of a Synchronous Walsh-Function Generator", IEEE Trans. electromagn. Compat., EMC-19, v4, p.407-410.

163. Fino, B.J. (1972). "Relations Between Haar and Walsh/Hadamard Transforms", Proc. IEEE, v60, n5, p. 647-8.

164. Fino, B.J. (1972). "Experimental Study of Picture Coding by the Haar and Complex Hadamard Transforms", Ann. Telecommun. (FR), v 27, n5-6, p. 185-208.

165. Fino, B.J., Algazi, V.R. (1974). "A Note on Parallel and Pipeline Computation of Fast Unitary Transforms", CA Univ., Berkeley Elect. Res. Lab., p. 8.

166. Fino, B.J., Algazi, V.R. (1974). "Slant Haar Transform", Proc IEEE, v 62, n5, p. 653-654.

Pipeline Computation of Fast Unitary Transforms", Elect. Lett. (GB), v11, n5, p. 93-4.

. Fino, B.J., Algazi, V.R. (1976). "Unified Matrix Treatment of the Fast Walsh-Hadamard Transform", IEEE Trans, Comput., C-25, n11, p. 1142-6.

. Fino, B.J., Algazi, V.R. (1977). "A Unified Treatment of Discrete Fast Unitary Transforms", Siam J. Comput., n4.

. Flickner, M.D., Ahmed, N. (1982) "Derivation for the Discrete Cosine Transform", Proc. of the IEEE, 70, v 9, p. 1132-1134.

. France, M.M. (1965). "Walsh Functions, Normal Numbers, and Pseudo-Random Functions", UC Berkeley, Dept. of Math, 2p.

. Frangoulis, E., Turner, L. (1978). "Speech Coding by the Hadamard-Haar Transform", IEE J. Comput. Digital Tech, v 1, n3, p 106-112.

. Frank, T.H. (1971). "Implementation of Dyadic Correlation", IEEE Trans. Electromagn. Compat. EMC-13, n3, p 111-17.

. French, A.S., Butz, E.G. (1974). "Use of Walsh Functions in the Wiener Analysis of Nonlinear Systems", IEEE Trans. Comput, C-23, n3, p 225-232.

. Frey, T., Nagypal, T. "The Fast Walsh-Transformation", Period. Polytech. Electr. Eng. (Hung) v 22, n2-3, 71-8.

. Fukui, I. (1976). "Properties of Walsh Transform by Galois Field GF(2)", Trans. Inst. Electron. & Commun., E59, n7, p.45-6.

177. Fukui, I. (1977). "Effects of Dyadic Similarity Transform in Walsh Space", Trans. Inst. Electron. and Commun., v E60, n4, p. 230.

178. Fukui, I. (1977). "Dyadic Difference in Walsh Transform", Trans. Inst. Electron. & Commun. E60, n7, p. 390.

179. Fukui, I. (1984). "Relations Between Poisson's Sum Formula Sampling Theorem and Signals on the Walsh Transform", Trans. Inst. Electron. & Commun. Part A, v J66A, n3, p.212-218.

180. Gaubatz, D.A., Kitai, R. (1974). "Programmable Walsh Function Generator for Orthogonal Sequency Pairs", IEEE Trans Electromagn Compat., EMC-16, n2, p 134-136.

181. Georgi, K.H. (1977). "Secrecy Coding with the Matrix Vocoder", Nachrichtentech Z. (Ger), v 30, n11, 93-4.

182. Gerasimov, L.V. (1975). "Complexity of the Walsh-Function Expansion of Binary Signals", Radioteknika, Moskva (USSR), v 30, n11, 93-4.

183. Gethoeffer, H. (1971). "Sequency Analysis Using Correlation and Convolution", IEEE Trans. Electromagn. Compat., EMC-13, n3, p 118-23.

184. Gethoeffer, H. (1973). "Transform Coding of Speech Using Walsh Functions", Appl. of Walsh Funct. Symp., 4th Proc., p 194-201.

185. Gibbs, J.E. (1967). "Walsh Spectroscopy, a Form of Spectral Analysis Well Suited to Binary Digital Computation", Unpublished Report, National Physical Laboratory, England.

Functions as Solutions of a Logical Differential Equaton", NPL-DES-1, p.11.
Gibbs, J.E., Millard, M.J. (1969). "Some Methods of Solution of Linear Ordinary Logical Differetial Equations", Nat. Phys. Lab. (Eng), p.36.
Gibbs, J.E. (1970). "Digital Filtering in Dyadic-Time and Sequency", Nat. Phys. Lab. (Eng), p.16.
Gibbs, J.E., Pichler, F.R. (1971). "Comments on Transformation of 'Fourier' Power Spectra into Walsh Power Spectra", IEEE Trans Electromagn. Compat., EMC-13, n3, p.51-4.
. Gibbs, J.E. (1975). "Differentiation and Frequency on Finite Abelian Groups", IEEE Trans. Electromagn. Compat., EMC-17, p. 542-3.
. Gibbs, J.E. (1977). "'Instant' Fourier Transform",Electron Lett. (GB), v 13, n5, p. 122-123.
. Girard, A. (1971). "Image Analysis and Multiplex Coding", Agard conf. Proc. #90, X+446.
. Gizdon, H. (1979). "Spectral Methods of the Synthesis of Logic Functions", Arch. Autom. & Telemech. (Pol), v 24, n3, p.385-95.
. Golden, J.P., James, S.N. (1971). "Implementation of Walsh Function Resonant Filter", IEEE Trans. Electromagn. Compat., EMC-13, n3, p 106-10.
. Gongli, Z. (1983). "Parameter Spectrum in Spectral Multiple-Valued Logic Design", Electron Lett., v 19, n6, p 199-200.

196. Gongli, Z. (1984). "Two Complete Orthogonal Sets of Real Multiple-Valued Functions", Proc. 14th Int. Symp. on Multiple-Valued Logic, p. 12-18.

197. Gopalsami, N., Deekshitulu, B. (1975). "Time-Domain Synthesis via Walsh Functions",, Proc. Inst. Electr. Emg. (Lond), v 123, n5, p 461-462.

198. Gordon, J.A., Barrett, R. (1971). "Digital Majority Logic - Multiplexer Using Walsh Functions", IEEE Trans. Electromagn. Compat., EMC-13, n3, p 171-176.

199. Grallert, H.J. (1980). "Application of Orthonormalized M-Sequences for Data Reduced and Error Protected Transmission of Pictures", Proc - Int Zurich Semin. on Digital Commun. Digital Transm. Wireless Syst., Seiss Fed. Inst. of Tech., Zurich, Switz, Publ by IEEE (Cat #80CH1521-4 Com). p G6.1-G6.5.

200. Griffiths, L.J. (1973). "Extraction of Target Information from Radar Signals which Use Walsh Function Modulation Formats", Appl of Walsh Funct, Symp, 4th Proc. Cath. U of Am, p 242-247.

201. Grooms, D.W. (1977). "Walsh Functions. (A Bibliography with Abstracts)", NTIS, Virginia, p 90.

202. Gubbins, D., Scollar, I., Fallside, F. (1973). "Two Dimensional Digital Filtering with Haar and Walsh Transform", Ann. Geophys. (Fr), v 27, n2, 85-104.

203. Gulamhusein, M.N., Fallside, F. (1973). "Short-Time Spectral and Autocorrelation Analysis in the Walsh Domain", IEEE Trans. Inf. Theory., IT-19, n5, p 615-623.

Boolean Function which is Independent of Some Arguments", Proc. Int. Workshop on Fault Detection and Spectral Techniques, p. 4.1-4.7.

Haar, A. (1910). "Zur Theorie Der Orthogonal Funktionensysteme", Math. Ann, v69, p. 331-371.

Hama, H., Yanashita, K. (1979). "Walsh-Hadamard Power Spectra Invariant to Certain Transform Groups", IEEE Trans. Systems, Man and Cybernetics, SMC-9, v4, p. 227-237.

Harmuth, H.F. (1972). "Information Transmission by Orthogonal Functions", Publ: Springer-Verlag, Berlin, Ger., p. XI+322.

Harmuth, H.F. (1969). "Applications of Walsh Functions in Communications", IEEE Spectrum,v6, n11, p. 82-91.

Harmuth, H.F. (1970). "Sequence Theory-State of the Art and Trends", Internat. Elektronische Rundschau (Ger), v24, n3, p. 73-5.

Harmuth, H.F. (1970). "Sequency Filters for signals With Two Space Variables and LCS Filters", Nachrichtentech. Z (Ger), v23, n8, p. 377-383.

Harmuth, H.F., Debuda, R. (1971). "Conversion of Sequency - Limited Signals into Frequency-Limited Signals and Vice Versa", IEEE Trans. Info. Theory, IT-17, n3, p. 343-344.

Harmuth, H.F. (1971). "Asynchronous Filters and Mobile Radio Communication Based on Walsh Functions", IEEETrans Electromagn. Compat., EMC-17, #3, p. 210-218.

213. Harmuth, H.F. (1972). "Applications of Walsh Functions in Communications: State of the Art", Publ Acad Press Inc., Signal Process, NATO Adv Study Inst. Proc. (Engl), p. 43-61.

214. Harmuth, H.F. (1972). "Sequency Filters Based on Walsh Functions for Signals with Two Space Variables", Patent #: USA 3705981, Assignees: Internat. Tel. & Tel. Corp. Original Patent Appl. #USA 77,996.

215. Harmuth, H.F. (1973). "Survey of Research and Development in the Field of Walsh Functions and Sequency Theory", Appl of Walsh Funct. Symp., 4th Proc., p. 1-9.

216. Harmuth, H.F., Briganti, E. (1975). "Comments on 'Sinusoids versus Walsh Functions", IEEE Trans. Electromagn. Compat., EMC-17, n3, p. 1994-1995.

217. Harmuth, H.F. (1977). "Sequency Theory: Foundations and Applications", Adv. Electron. Electron. Phys. Suppl., n9, p. 511.

218. Hashim, A. (1974). "Class of Linear Binary Codes", Proc. Inst. Electr. Eng. (Lon), v 121, n7, p. 555-558.

219. Hashim, A. (1975). "Class of Binary Codes", Proc. Inst. Electr. Eng. (GB), v 122, n1, p 47.

220. Hazra, L.H. (1975). "New Class of Optimum Amplitude Filters", Opt. Commun., v 21, n2, p. 232-236.

221. Helm, H.A. (1971). "Group Codes and Walsh Functions", Proc. 1971 Symp. on Applic. of Walsh Functions, Washington, D.C., p.78-83, p.13-15.

Functions", IEEE Trans. Electromagn. Compat., EMC-13, n3, p. 78-83.

Henderson, K.E. (1970). "Comment on Computation of the Fast Walsh-Fourier Transform ", IEEE Trans. Comput., C-19, n9, p. 850-7.

Henderson, K.W. (1974). "Walsh Summing and Differencing Transforms", IEEE Trans. Electromagn. Compat., EMC-16, n2, p. 130-134.

Henderson, K.W. (1975). "Simplification of the Computation of Real Hadamard Transforms", IEEE Trans. Electromagn. Compat., EMC-17, n3, p.185-8.

Herger, P. (1974). "Investigation of Redundancy Reducing Coding of Speech Signals in the Fourier and Walsh Domain", Tech. Hockschule, Darmstadt (W. Ger), Report #IND-FB-64, p. 23.

Herron, R.L. (1977). "Comparison of Fast Fourier Transforms with Other Transforms in Signal Processing for Tactical Radar Target Identification", AF Inst of Tech. Wright-Patterson AFB, Ohio Sch of Eng. Report #AFIT/GE/EE/77-20, p. 179.

Horn, W., Trappl, R. (1982). "Fast Walsh versus Fast Fourier Transform; A Comparison of Time Efficiency", Publ. Hemisphere Publ. Corp., USA & London, p. 329-332.

Hostetter, G.H. (1983). "Recursive discrete Walsh-Hadamard Transformation", Proc. IEEE, v 71, n2, p. 271-2.

Hsiao, T.C. (1982). "The Use of the Rademacher-Walsh Spectrum for Data Compression in Logic Testing", Ph.D. Dissertation, University of Nebraska.

231. Hsiao, T.C., Seth, S.C. (1982). "The Use of Rademacher-Walsh Spectrum in Testing and Design of Digital Circuits", Proceed of Int. Conf. on Circuits and Computers, p. 1-4.
232. Hubner, H. (1970). "On the Transmission of Walsh Modulated Multiplex Signals", Proc Applications of Walsh Functions Sym. & Workshop, p. 41-5.
233. Hubner, H., Kremer, H. (1970). "Binary Ordered Walsh Functions", Commun. Assoc. Comput. Mach., v 13, n8, p. 511.
234. Hubner, H. (1970). "Sequency Ordered Walsh Functions", Commun. Assoc. Comput. Mach (USA), v13, n8, p. 511.
235. Hubner, H. (1980). "Information Transmission by Non-Sinusoidal Means. IV", Fernmelde-Ing. (Ger), v34, n5, P. 1-17.
236. Hubner, H. (1970). "Analog and Digital Multiplexing by Mans of Walsh funcitons", Nachrichtentechnische Aeit, v 23, n8, p.384-390.
237. Hurst, J. (1978). "Walsh Adaptive Filter", Report #: RADC-TR-78-82, p.68.
238. Hurst, S.L. (1978). "The Logical Processing of Digital Signals", Edward Arnold.
239. Hurst, S., Landheld, E. (1981). "Spectral representation of Binary Logic Functions - 1,2 Elektronik, v30, n13, p.61-66, n14 p.69-74.
240. Hurst, S.L. (1979). "Engineering Consideration of Spectral Transforms for Ternary Logic Synthesis", Comput J, v22, n2, p.173-183.
241. Hurst, S.L. (1979). "An Engineering Consideration of Spectral Transforms for Ternary Logic Synthesis", Comput.J. (GB), v22, n2, p.173-183.

Network Synthesis", Publ: IEEE Comput Soc Press Cat. #81CH1611-3, p. 10-18.

. Ilmurzynski, J. (1975). "Walsh Functions and Walsh-Hadamard Transforms", Tech. Radia and Telew., v 4/20; n3, p.8-20.

. Ito, T. (1970) "Applications of the Walsh Functions to Pattern Recognition and Switching Theory", Proc. Applications of Walsh Functions, Symp & Workshop, Washington D.C., p.128-37.

. Jacoby, B.F. (1977). "Walsh Functions: A Digital Fourier Series", Byte (USA), v 2, n 9, p.190-8.

. Janicke, O. (1980). "Design of a Real Value Sequential Logic Automation System Using the Walsh Transform", Wiss Z. Tech. Univ Dresden (Germany), v 29, n1, p.221-6.

. Janicke, O. (1976). "Discrete Walsh Functions", Wiss Z. Tech Univ. Dres. (Germany), v 25, n4, p.813-16.

. Janicke, O. (1978). "The Walsh Transformation Applied to Cellular Structures", Z. Elekt. Inf. and Energietech. (Germany), v8, n6, p.552-61.

. Jiang, Z., Jiang, W. (1982). "New Approach to Bilinear Systems Identification and Its Application.", Proceeding of the 6th IFAC Symposium. Washington, DC, USA.

. Jones, M.W., Mein, D.N., Knauer, S.C. (1978). "The Karhumen - Loeve Discrete Cosine and Related Transforms Obtained via the Hadamard Transform," Int. Telemetiring Comf., Los Angeles.

251. Judah, N.B. (1977). "Introduction to Walsh Function", Trans. S. Africa Inst. Electr. Eng. (S. Africa), v 68, Pt.12, p.198-304.

252. Kahveci, A.E., Hall E.L. (1974). "Sequency Domain Design of Frequency Filters", IEEE Trans. Comput. C-23, n9, p.976-81.

253. Kalat, J. (1982). "Identification of Time-Varying Parameter Via Walsh Functions in Distributed Parameter System.", 10th IMSCS world Congress on System Simulation and Scientific computation, v 3, Modeling and Simulation in Engineering; Modeling and simulation - general, Montreal, Canada.

254. Kane, J. (1970). "Matrix Inversion by Walsh Functions", Proc Applications of Walsh Functions. Symp & Workshop, Washington, DC, p. 157-60.

255. Kapitckii, Ya.I., Tsapenko, M.P. (1972). "Digital-Analogue Functional Convertors Based on the Fourier-Walsh Transformation", Avtometria (USSR), n4, p.97-104.

256. Karpala, F., Jernigan, M.E. (1980). "Extraction of Periodic Signals Using the Haar Transform", Proceedings of the International Conference on Cybernetics and Society, Boston, p.318-322.

257. Karpovsky, M.G., Moskalev, E.S. (1967). "Realization of a System of Logical Functions by Means of Expansion in Orthogonal Series", Automat. and Remote Control, v.28, n.12, pp. 1921-1932. (Translated from Autom. and Telemekh. (USSR), n.12, p.119-129).

"Utilization of Autocorrelation Functions for the Implementation of Systems of Logical Functions", Automat. and Remote Control, v.31, n.2, p. 243-250. (Translated from: Autom. and Telemekh. (USSR), n.2, p.83-90).

. Karpovsky, M.G., Moskalev, E.S. (1970). "Realization of Partially Defined Logical Functions by Means of Expanding into Orthogonal Series", Automat. and Remote Control, v.31, n.8, p.1278-1288. (Translated from: Autom. and Telemekh. (USSR), n.8, p.89-99).

. Karpovsky, M.G. (1971). "Correction of Errors in Automata with Combination Part Realized by Means of Expansion into Orthogonal Series", Avtom. nd Telemekh. (USSR), n.9, p.204-7.

. Karpovsky, M.G., Moskalev, E.S. (1970). "Spectral Methods of Analysis and Design of Switching Circuits", Monograph, Energy Publ. House (USSR).

. Karpovsky, M.G., Moskalev, E.S., Troianovsky, A.A. (1974). "Estimations on Error-Correction Capabilities of Logical Functions", Izvestia Acad. Nauk USSR, v.12, n.1, p.155-162.

. Karpovsky, M.G., Troianovsky, A.A. (1974). "Methods for Analyzing the Correcting Power of Automata", Automatic Control and Computer Science, v.8, n.1, p.22-27.

. Karpovsky, M.G. (1976). Finite Orthogonal Series in the Design of Digital Devices, Halstead Press (John Wiley & Sons), New York-Toronto, Ont.; Israel Universities Press, Jerusalem.

265. Karpovsky, M.G. (1977). "Error Detection in Digital Devices and Computer Programs with the Aid of Linear Recurrent Equations Over Finite Commutative Groups", IEEE Trans. Comput., C-26, n.3, p. 208-18.

266. Karpovsky, M.G. (1977). "Harmonic Analysis over Finite Commutative Groups in Linearization Problems for Systems of Logical Functions", Information and Control, v.33, p.142-165.

267. Karpovsky, M.G., Trachtenberg, E.A. (1977). "Some Optimizations Problems for Convolution Systems over Finite Groups", Information and Control, v.34, p.122.

268. Karpovsky, M.G. (1977). "Fast Fourier Transfoms over Finite NonAbelian Groups", IEEE Trans. Comput., C26, n10, p.10281031.

269. Karpovsky, V.G., Trachtenberg, E.A. (1977). "Linear Checking Equations and ErrorCorrecting Capabilities of Computation Chaneels", Proc. IFIP Congress, 1977, North Holland, p.619624.

270. Karpovsky, M.G., Trachtenberg, E.A. (1978). "Fourier Transforms over Finite Groups for Error Detection and Error Correction in Computation Channels", Information and Control, v.40, n2, p.335353.

271. Karpovsky, M.G. (1979). "Error Detection for Polynomial Computations", Comput. Digital Tech., v. 2, p. 50-56.

272. Karpovsky, M.G. (1979). "On Weight Distribution of Binary Linear Codes", IEEE Trans. Inf. Theory IT-25, n.1, p.105-109.

273. Karpovsky, M.G. (1980). "Testing for Numerical Computations", IEEE Proc. E.(GB), v. 127, n.2,p.69-76.

Translates, Covering Radius, and Perfect Codes Correcting Errors of Given Weights", IEEE Trans. Inf. Theory (USA), IT-27, n. 4,p.462-72.

. Karpovsky, M.G. (1984). "Spectral Methods of Decomposition Design and Testing of MultipleValued Logical Networks", Keynote paper, Proc. 11th Int. Symp. on MultipleValued Logic, p110.

. Karpovsky, M.G. (1982). "Testing for Multiple-Valued Computations", Proc. 12th Int. Symp. on MultipleValued Logic, Paris, France.

. Karpovsky, M.G. (1982). "Detection and Location of Errors by Linear Inequality Checks", IEEE Proc., v129, p.86-92.

. Karpovsky, M.G., Trachtenberg, E.A. (1985). "Evaluation of Performance of a Ceass of Generalized Wiener Fieters", IEEE Trans on Inf. Theory. (to be published)

. Kawamura, M., Tanaka, S. (1977). "Walsh Transform of a Sampled Function on a Finite Interval and the Sampling Theorem", Trans. Inst. Electron and Commun. Eng. Jpn. Sect. E (JAPAN), v.E60, N.5, p. 276.

. Kekre, H.B., Solanki, J.K. (1977). "Modified Slant and Modified Slant Haar Transform for Image Data Compression", Comput. Electr. Eng., v.4, n.3, pp. 199-206.

. Kekre, H.B., Sahasrabudhe, S.C., Ramarao V. (1981). "Walsh Spectrum of Monotone Boolean Functions",IEEE Trans. Electromagn. Compat., v.23, n.3, Pt.1, pp.156-160.

282. Kellermayr, K.H. (1980). "Application of Walsh Functions in Control Engineering", Progress in Cybernetics and Systems Research, v.10 (Part of the Proceedings of the 5th European Meeting on Cybernetics and Systems Research, Vienna, Austria.

283. Kelliher, E.G. (1978). "Direct Electronic Transforms for Feature Extraction", Undersea Research Corp., Falls Church VA, Report No. ETL-0139, 33p.

284. Kennedy, J.D. (1971). "Experimental Walsh Transform Image Processing",Proceedings 4th Annual Hawaii International Conference on System Sciences, p.233-5, Western Periodicals Co., North Hollywood.

285. Kennedy,J.D. (1971). "Walsh Function Imagery Analysis", IEEE Trans. Electromagn.Compat., EMC-13, n.3, pp.7-10.

286. Kennett, B.L.N. (1970). "A Note on the Finite Walsh Transform", IEEE Trans. Inform. Theory IT-16, n.4, pp. 489-91.

287. Keshavan, H.R., Narasimhan, M.A., Srinath, M.D. (1977). "Application of Orthogonal Transforms in the Enhancement of Images in the Presence of Additive Noise", Comput. Electr. Eng., v.4, n.4, pp.279-295.

288. Keskin, Umit (1983). "Simple Analog Approach to Fast Walsh Transform", Int. J. Electron., v.55, n.2, pp.309-311.

289. Kilgore, T.A., Cheney,E.W. (1974). "A Theorem on Interpolation in Haar Subspaces", Texas Univ Austin Center for Numerical Analysis, Report No. CNA-80; AFOSR-TR-74-0685, 18pp.

of Highly Orthogonal Walsh Functions", Telecommun. Radio Eng., v.36-37, n.7, pp.110-113.

Kitahasi, T., Tanaka, A. (1972). "Orthogonal Expansion of Many-Valued Logical Functions and its Application to their Realization with Single-Threshold Element", IEEE Trans. Comput., v. C-21, pp. 211-218.

Kitai, R, Siemens, K.H. (1972). "A Hazard-Free Walsh Function Generator", IEEE Trans. Instrum. and Meas., IM-21, n. 1, pp.80-83.

Kitai, R., Siemens, K.H. (1972). "Comments on A Simplified Definition of Walsh Functions", IEEE Trans. Comput., C-21, n.5, p.512.

Kitai, R., Renyi, I., Vajda, F. (1976). "Using a Microprocessor in a Walsh-Fourier Spectral Analyser", Computer, v.9, n.4, pp.27-31.

Kitai, R., (1979). "Walsh-Function Array Generators: a Comparison", IEEE Trans. Electromagn. Compat. v.EMC-21, n.2, pp.153-154.

Kitai, R., Siemens, K.H. (1979). "Discrete Fourier Transform Via Walsh Transform", IEEE Trans. Acoust.Speech Signal Process, ASSP-27, n3, p.289.

Ko, W.L., Mittra, R. (1978). "On the Use of Walsh-Hadamard Transforms for the Computation of Radiation Patterns of Aperture Antennas", 1978 International Symposium Digest (USA), pp. 207-20, New York.

Koch, Roland W., Paul, Clayton R. (1973). "Generation of Walsh Function Expansion Coefficients", Proc. of the 4th Annual Symposium on the Application of Walsh Function, pp.268-269, NTIS (AD-763-000), Springfield VA.

299. Kowalski, B.R., Bender, C.F. (1973). "The Hadamard Transform and Spectral Analysis by Pattern Recognition", Anal. Chem. (USA) v.45, n.13, pp.2234-9.

300. Kremer, H. (1971). "Algorithms for the Haar Functions and the Fast Haar Transform", Proc. Symp. Theory Appl. Walsh Functions, Hatfield, United Kingdom.

301. Kremer, H. (1973). "On the Representation of Walsh Functions and Fast Walsh Transform Algorithms", Angew. Inf. (Germany), n.1, pp.7-20.

302. Kremer, H., Gethoffer, H. (1975). "A Unified Representation of Walsh Functions and Convolution Transforms", Electromagnetic Compatibility 1975, p.544.

303. Krenkel, T.E. (1975). "Spectral Analysis on Finite Commutative Groups", Telecommun. Radio Eng., v.29-30, n.6, pp.71-75.

304. Krivenkov, B.E., Tverdokhleb, P.E., Chugui, Yu. V. (1974). "Optical Method of Image Coding Using the Hadamard Transform", Avtometriya (USSR), n.6, pp.32-40.

305. Krivenkov, B.E., Teverdokhleb, P.E., Chugui, Yu.V. (1975). "Analysis of Images by Hadamard Optical Transform", Appl. Opt., v.14, n.8, pp.1829-1834.

306. Kuklinski, W.S. (1981). "A Fast Walsh Transform ECG Data Compression Algorithm", Proceedings of the 5th Annual Symposium on Computer Applications in Medical Care, pp.477-81.

307. Kuklinski, W.S. (1983). "Fast Walsh Transform Data-Compression Algorithm: ECG Applications", Med. and Biol. Eng. and Comput. (GB), v.21, n.4, pp.465-72.

Transform and the R Transform in Ordered Form", IEEE Trans. Comput.C-24, n.11, p.1120-1.
. Kunysz, K. (1972). "Discrete Walsh Transformation Applied to the Analysis of Random Sequences", Arch. Autom. and Telemech. (Poland), v.17, n.1, pp.31-7.
. Kunz, H.O. (1978). "Walsh Matrices", AEU Arch. Elektron. Uebertrag Electron. Commun., v.32, n.2, pp.56-5.
. Kunz, H.O. (1979). "On the Equivalence Between One-Dimensional Discrete Walsh-Hadamard and Multidimensional Discrete Fourier Transforms", IEEE Trans. Comput.,C28, n.3, pp.267-268.
. Labunec, V.G., Sitnikov, O.P. (1976). "Generalized Fast and Fourier Transforms on an Arbitrary Finite Abelian Group", Izdanie Ural. Politehn. Inst., Sverdlovsk, pp.24-43..
. Lackey, R.B. (1971). "So What's a Walsh Function?", Proceedings of the IEEE Fall Electronics Conference, p.368-71.
. Lackey, R.B., Meltzer, D. (1971). "A Simplified Definition of Walsh Functions", IEEE Trans. Comput., C-20, n.2, p.211-13.
. Lackey, R.B. (1972). "The Wonderful World of Walsh Functions", Proceedings of the IEEE 1972 International Conference on Communications, 38-1/5pp.
. Lamquin, M. (1973). "Study of the Fast Walsh Transform", Rev. HF. (Belgium), v.9, n.1, pp.3-9.
. Lange, H.J. (1979). "Representation of Walsh Matrices", Z. Elektr. Inf. and Energietech. (Germany), v.9, .n2, pp.135-42.

318. Larsen, R.D., Madych, W. R. (1976). "Walsh-Like Expansions and Hadamard Matrices", IEEE Trans. Acoust., Speech and Signal Process., ASSP-24, n.1, pp.71-5.

319. Larsen, H. (1976). "An Algorithm to Compute the Sequency Ordered Walsh Transform", IEEE Trans. Acoust., Speech and Signal Process., ASSP-24, n.4, pp.335-6.

320. Lechner, R.J. (1968). "A Transform Approach to Logic Design," IEEE Trans, c-19(7), pp. 672-680.

321. Lechner, R.J. (1971). Harmonic analysis of Switching Functions, in "Recent Developments in Switching Theory." (A Mukhopadhyay, ed.). Academic Press, New York.

322. Lechner, R.J. (1970). "Comment on Computation of the Fast Walsh-Fourier Transform ", IEEE Trans. Comput., C-19, n.2, p.174.

323. Lechner, R.J., Moezzi, A. (1984). "Sysnthesis of Encoded Programmable Logic Arrays", Proc. Int. Workshop on Fault Detectiton and Spectral Techniques. p.1.1-1.13.

324. Le-Dinh-Chon-Tam, Goulet, R.Y. (1972). "On Arithmetical Shift for Walsh Functions", IEEE Trans. Comput., C-21, n.12, p.1451-2.

325. Lee,J.S. (1970). "Generation of Walsh Functions as Binary Group Codes", Proc. Applications of Walsh Functions, Washington, DC, p.58-61.

326. Lee, J.S. (1973). "Digital Generation of Walsh-Functions for Orthogonal Multiplexing Applications", Appl. of Walsh Funct., Symp., 4th, Proc., Washington, DC, p.222-227.

Filters Based on Walsh Functions", Proc. Applications of Walsh Functions, Washington, DC, p.7-11.

. Levy, P. (1944). "On a generalization of the Rademacher Orthogoanl Functions",Commentarii Mathematica Helvetica, 16, p.146-152.

. Li, Z., Zhang, Q. (1983). "Ordering of Walsh Functions", IEEE Trans.Electromagn. Compat., EMC-25, n.2, pp.115-19.

. Liebler, M.E., Roesser, R.P. (1971). "Multiple Real-Valued Walsh Functions", Proc. IEEE Theory Appl. Multiple-Valued Logic Design, p.84-102.

. Liebler,M.E., Roesser, R.P. (1977). "Multiple-Real-Valued Walsh Functions", Computer Science and Multiple-Valued Logic, North-Holland, Amsterdam, Netherlands, p.535-48.

. Lilein, A.L. (1981). "Walsh Spectrum Transformation when there is Signal Shift", Telecommun. Radio Eng., v.35-36, n.1, pp.50-55.

. Lloyd, A.M. (1978). "Spectral Addition Techniques for the Synthesis of Multivariable Logic Networks", IEE Comput. Digital Tech., v.1, p.152-164.

. Lloyd, A.M. (1979). "Consideration of Orthogonal Matrices, Other Than the Rademacher-Walsh Types, for the Synthesis of Digital Networks", Int. J. Electron., v.47, n.3, p.205-212.

. Lloyd, A.M. (1980). "Design of Multiplexer Universal-Logic-Module Networks Using Spectral Techniques", IEE Proc. E (GB), v.127, n.1, p.31-6.

336. Lloyd, A.M. (1980). "Orthogonal transforms in digital logic design", Ph.D. Thesis. University of Bath, United Kingdom.

337. Lopresti, Ph.V. (1974). "Fast Algorithm for the Estimation of Autocorrelation Functions", IEEE Trans Acoust Speech Signal Process, ASSP-22 p. 449-53.

338. Lui, P.K. (1983). "The Application of Spectral Techniques to the Detection of Single and Multiple Stuck-at Faults in Irredundant Computational Networks". M.Sc. Thesis. University of Manitoba, Canada.

339. Luke, H.D. (1970). "Binary Orthogonal Functions in Communication Engineering", Internat. Elektronische Rundschau (Germany), v.24, n.1, p. 1-3.

340. Lynch, R.T., Reis, J.J. (1976). "Haar Transform Image Coding", National Telecommunications Conference.

341. McCall, D.C. (1973). "3-to-1 Data Compression Via Walsh Transform", Report No.:NELC-TR-1903, p.35.

342. McCall, D.C. (1973). "Data Compression Using Walsh Transform Source Encoding", Nav. Res. Rev. (USA), v.27, n.5-6, p.49-56.

343. McCanny, J.V., McWhirter, J.G., Roberts, J.B.G., Day, D.J., Thorp, T.J. (1982). "Bit Level Systolic Arrays", Fifteenth Asilomar Conference on Circuits, Systems and Computers, p.238-42.

Expansions", 21st Midwest Symposium on Circuits and Systems, p.388-92.

Manoli, S.H., (1971). "Walsh-Function Generator", Proc. IEEE (USA), v.59, n.1, p.93-4.

Maqusi, M. (1972). "On Generalized Walsh Functions and Transform", Proceedings of the 1972 IEEE Conference on Decision Control and 11th Symposium on Adaptive Processes, p.499-502.

Marqusi, M. (1973). "On Moments and Walsh Characteristic Functions", IEEE Trans. Commun., Com-21, n.6, p.768-70.

Marqusi, M. (1978). "A Sampling Theorem for Dyadic Stationary Processes", IEEE Trans. Acoust., Speech and Signal Process. ASSp-26, n.3, p.265-7.

Marqusi, M. (1978). "On the Walsh Analysis of Nonlinear Systems", IEEE Trans. Electromagn. Compat., EMC-20, n.4, p.519-23.

Mar, Henry Y.L., Sheng, C.L. (1973). "Combinatorial Network for the Multi-Dimensional Logical Walsh Transform", Appl of Walsh Funct, Symp, 4th, Proc., Cathol Univ of Am, Washington, DC.

Marimont, A.L., Radimov, A.P., Stogov, G.V. (1975). "The Rate of Generation of Information by a Source Which Uses Orthogonal Expansion in Terms of Haar Functions", Radiotekhnika, Moskva (USSR), v.30, n.9, p.30-5.

Matyushin, O.T. (1980). "Fast Code-Phase Converter", Radiotekhnika, Moskva (USSR), v.35, n.7, p.39-42.

353. Mauersberger, W. (1977). "Haar, Walsh, Slant, and Discrete Cosine Transform Coding of Images-A Comparison", 2nd Symposium and Technical Exhibition on Electromagnetic Compatibility, p.37-42.

354. Miller, D.M., Muzio, J.C. (1979). "The Distribution of Symmetry Information in the Spectrum of a Boolean Function", Electron. Lett., v. 15, p. 816-817.

355. Miller, D.M., Muzio, J.C. (1979). "Detection of Symmetries in Totally Specified or Partially Specified Combinational functions", IEE J. Comput. Digital Tech. 2, p.203-9.

356. Miller, D.M., Muzio, J.C., Hurst, S.L. (1979). "Spectral Method of Boolean Function Complexity", IEEE Electron. Lett. 18, p.572-4.

357. Miller, D.M. (1980). A spectral estimate of function complexity, in NATO Final Report 1623, "An Integrated Theory of Digital Logic Employing Rademacher-Walsh Transforms and Two-Place Decompositions." University of Bath, United Kingdom.

358. Miller, D.M. (1981). "Special Symmetry Tests", Proc. 11th Internat. Symp.Multiple-Valued Logic, p. 130-134.

359. Miller,D.M., Muzio,J.C. (1985). Spectral Fault Signatures for Single Stuck-at faults in Combinational Networks," Submitted to IEEE Trans. on Comput.

360. Miller, D.M., Muzio, J.C. (1981). "Spectral Methods for Fault Detection in Combinational Circuits," Technical Report, Tektronix, Inc..

Signatures for Fault Testing in Combinational Circuits," Technical Report, Tektronix, Inc..
Miller, D.M., Muzio, J.C., Hurst, S.L., (1985). "Multi-variable Symmetries and Their Detection," IEEE Proc. to appear.
Moharir, P.S. (1974). "Walsh-Fourier and Trigonometric Secrecy Coding. I. Walsh-Fourier Secrecy Coding", J. Inst. Electron. and Telecommun. Eng. (India), v.20, n.5, p.170-3.
Moharir, P.S. (1974). "Permutation Properties of Discrete Walsh Transform Pair", J. Inst. Electron. and Telecommun. Eng. (India), v.20, n.12, p.593-7.
Moon, D.L. "Analog and Digital Resonant Sequency Filters for Walsh Functions", Ohio State University, Columbus, p.170.
Morettin, P.A., (1981). "Walsh Spectral Analysis", Siam Rev. (USA), v.23, n.3, p.279-91.
Moraga, C. (1976). "Ternary Spectral Logic", Report No. AIUD/23/76, University of Dortmund.
Moraga, C. (1977). "Ternary Spectral Logic", Proc. IEEE 7th Internat.Symp. Multiple-Valued Logic, p.7-12.
Moraga, C. (1978). "Spectral Logic Design", Bericht 57/58, Abteilung Informatik, Universitat Dortmund.
Moraga, C. (1978). "Complex Spectral Logic", Proceedings of the Eighth International Symposium on Multi-Valued Logic, p.149-56.
Moraga, C. (1978). "Introducing Disjoint Spectral Translation in Multi-Valued Logic Design",Electron. Lett. (GB), v.14, n8, p. 241-3.

372. Moraga, C. (1978). "Logic Design of Multiple-Valued Switching Circuits Using Modulo Adders", Circuit and Theory Design, p. 478-82.
373. Moraga, C. (1979). "Spectral Characterisation of Ternary Threshold Functions", Electron. Lett., v.15, n.22, p.712-3.
374. Moraga, C. (1979). "Characterisation of Ternary Threshold Functions Using a Partial Spectrum", Electron. Lett., v.15, n.24, p.803-5.
375. Moraga, C. (1981). "On a Property of the Chrestenson Spectrum," Report No. AIUD/MVL/8102, University of Dortmund.
376. Moraga, C., Sesere, K. (1984). "Spectral Methods in Pattern Analysis", Proc. Int. Workshop on Fault Detection and Spectral Techniques, p. 6.1-6.14.
377. Mukhopadhyay, A. (Ed.), (1971). "Recent Developments in Switching Theory," Academic Press. New York.
378. Muzio, J.C. (1977). "Non-orthogonal Transforms for Logical Design," Technical Report CS.77006-R. Virginia Polytechnic Institute and State University.
379. Muzio, J.C. (1977). "The Evaluation of Large Magnitude Orthogonal Spectral Coefficients", University of Manitoba Scientific Report 87.
380. Muzio, J.C. (1977). "The Decomposition of Rademacher-Walsh Spectra," Technical Report CS7707-R, Virginia Polytechnic Institute and State University.
381. Muzio, J.C. (1977). "Concerning Transform for Three-valued Systems," University of Manitoba Technical Report CS77001/R.

of Sum and Product Functions", IEE J. Comput. and Digital Tech. (GB) v.1, n.113-18.

Muzio, J.C., Hurst, S.L. (1978). "The Computation of Complete and Reduced Sets of Orthogonal Spectral Coefficients for Logic Design and Pattern Recognition Purposes", Comput. Electric. Engrg. v. 5, p.231-249.

Muzio, J.C. (1979). "Concerning Low-Order Spectral Coefficients", IEE Comput. Digital Tech., v. 2, p.179-202.

Muzio, J.C. (1980). "Composite Spectra and the Analysis of Switching Circuits", IEEE Trans. Comput., C-29, p.750-753.

Muzio J.C., Miller J.M. (1982). "Spectral Techniques for Fault Detection," Proc. of 12th Int. Symposium on Fault Tolerant Computing, USA, p. 297-392.

Muzio J.C., Miller D.M. (1983). "Spectral Fault Signatures for Internally Unate Combinational Networks," IEEE-TC . (to appear)

Nacht, G.G. (1970). "Walsh Function Generator", Department of the Navy Washington DC, Report No.: PAT-APPL-66 418, Patent-3 701 143,p.7.

Nakatsuyama, M., Nishizuka, N. (1981). "The Fast Walsh-Hadamard Transform and Processors By Using Delay Lines", Trans. Inst. Electron. and Commun. Eng. Jpn. Sect. E (Japan), v.E64, n.11, p.708-15.

Nawrath, R. (1974). "Image Processing with Walsh Functions", Fernseh- and Kino-Tech. (Germany), v.28, n.12, p.361-3.

391. Nawrath, R. (1975). "Adaptive Walsh Transform of Images", Electromagnetic Compatibility, Montreux, Switzerland.

392. Nelson, D.R., Ziemer, E.R. (1973). "Digital Processing of Signals Using the fast Walsh Transform.", IEEE Southeast-Con, Proc, Reg 3 Conf Louisville, KY, Pap I-5, p.6.

393. Nezhevenko, E.S., Potaturkin, O.I., Tverdokhleb, P.E. (1972). "Linear Optical Systems for Performing Generalized Integral Tranformations", Avtometriya (USSR), n.6, p.88-90.

394. Nicholson, P.J. (1971). "Algebraic Theory of Finite Fourier Transforms", J.of Computer and Systems Science, v.5, p.524-547.

395. Nick, H.H. (1980). "Binary Logic Walsh Funciton Generator", IBM Tech. Disclosure Bull. (USA), v.22, n.10, p.4650-1.

396. Nightingale, D. (1977). "Walsh Functions", Telecommun. J. Aust. (Australia), v.27, n.27, p.62-3.

397. Ninomiya, I. (1961). "A Study of thef Structure of Boolean Functions and Its Application to the Synthesis of Switching Circuits", Mem.Fac. Eng., Nagoya Univ., 13(2).

398. Ohnsorg, F.R. (1971). "Spectral Modes of the Walsh-Hadamard Transform", IEEE Trans. Electromagn. Compat., EMC-13, n.3, pp. 55-9.

399. Ohnsorg, F.R. (1971). "Properties of Complex Walsh Functions", IEEE Fall Electron Conf. Proc., Chicago, IL, p. 383-5.

in Terms of Shifted Rademacher Functions and Its Applications to the Signal Processing and the Radiation of Electromagnetic Walsh Waves", IEEE Trans. Electromagn. Compat., EMC-18, n4, p. 201-205.

. Palanisamy, K.R. (1982). "Analysis of Non-Linear Systems Via Single Term Walsh Series Approach", Int. J. Syst. Sci., v 13 n 18, p. 929-935.

. Palanisamy, K.R., Rao, G.P. (1983). "Optimal Control of Linear Systems with Delays in State and Control Via Walsh Functions", IEE Proc. D (GB) v. 230, n.6, p.300-12.

. Paley, R.E.A.C. (1932). "A Remarkable Series of Orthogonal Functions", Proc. London Math. Soc. 34(2), p.241-79.

. Paraskevolpoulos, P.N., Bounas, A.C. (1978). "Distributed Parameter System Identification Via Walsh Transform", Int. J. Syst. Sci., v9, n1 , p 75-83.

. Paraskevopoulos, P.N., Vachtsevanos, G.J. "On the Transfer Function Matrix Identification of Two-Dimensional Systems", School of Engng., Democritus U. of Thrace, Xanthi, Greece; Tzafestas, S.G. (Editors).

. Paraskevopoulos, P.N., Varoufakis, S.J. (1980). "Transfer Function Determination From Impulse Response Via Walsh Functions", Int. J. Circuit Theory Appl., v 8, n 1, p 85-89.

407. Parkyn, W.A. (1971). "Sequency and Periodicity Concepts in Imagery Analysis", McDonnel Douglas Astron. Co., Huntington Beach, CA, Proc. 4th Hawaii Intn'l Conf. on System Science, p229-32.

408. Parkyn, W.A. (1972). "Two-Dimensional Fast Correlation and Convolution by Means of Walsh Transforms", McDonnel Douglass Astron. Co., Ca.; Report #MDC-G3007; AFOSR-TR-72-1339, 15p.

409. Pau, L.F. (1978). "Fast Testing and Trimming of A/D and D/A Converters in Automatic Test Systems", Dept. of Elec. and Phys., ENS Telecommunications, Paris, Autotestcon '78, Int'l Testing Conference, p.268-74.

410. Pearl, J. (1974). "Basis Restricted Transformations and Performance Measures for Spectral Representations", IEEE Trans. on Info. Theory, IT-17, p.751-753.

411. Pearl, J. (1970). "Application of Walsh Transform to Statistical Analysis", Cal. U. Los Angeles School of Eng. & Applied Science; Report #UCLA-ENG-7072 , p. 43.

412. Pearl, J., Andrews, H.C., Pratt, W.K. (1972). "Performance Measures for Transform Data Coding", UCLA Dept. of Eng. Systems Corp. Source Codes: 407790, p. 5.

413. Pearl, J. (1973). "Walsh Processing of Random Signals", UCLA, ZEEK, R.W.; Showalter, A.E.; Proc. of the 1971 Sympo. on Applic. of Walsh Functions. p. 137-141.

Transforms in Information Processing Applications", UCLA School of Eng. & Applied Science; Report #UCLA-ENG-7387, p.14

Pearl, J. (1975). "Optimal Dyadic Models of Time-Invariant Systems", IEEE Trans. Comput., C-24, p.598-602.

Peterson, H.L. (1970). "Generation of Walsh Functions", Proc. Applications of Walsh Flnctions. symp & Workshop, Washington DC, p. 55-7.

Piacente, L., Venturini, I. (1971). "Applications of New Orthogonal Functions in the Realization of Networks for Future Communications of Data Transmission", Proc. of the 18th Int'l Congress on Electronics, p.399-408.

Pichler, F. (1970). "Walsh Functions and Linear System Theory", Proc. Applications of Walsh Functions. Symp & Workshop, Washington, D.C., p. 175-182.

Pichler, F. (1970). "Some Aspects of a Theory of Correlation with Respect to Walsh Harmonic Analysis", Maryland U. College Park Dept. of Elec. Eng. Corp. Source Codes: 388449; Report No.: R-70-11; AFOSR-70-2594TR, p. 77.

Pichler, F. (1971). "On State-Space Description of Linear Dyadic-Invariant Systems", Proc. of the 1971 Symposium on Applications of Walsh Functions, p. 166-170.

Pichler, F., (1971). "On Discrete Dyadic Systems", Proc. Symp. Theory Appl. Walsh Functions, Hayfield, United Kingdom, p.1-17.

422. Pichler, F. (1972). "On the Theory of Generalized Convolution Systems: Dyadic Convolution Systems and Walsh Functions", Elektron. Informationsverarb. Kybern. (Germany), v. 8, n. 4, p. 197-209.

423. Pichler, F., (1972). "Walsh Functions Introduction to the Theory", Signal Proc. NATO Adv. Study Inst., Proc. Loughborough U. of Technol, Leicestershire, Eng., p. 23-41.

424. Picton, P.D. (1980). "Clock-Steering Synthesis Using Spectral Techniques", IEE Electron. Lett. 16, p.409-411.

425. Picton, P.D. (1981). "Realisation of Multithreshold Logic networks Using the Rademacher-Walsh Transform", School of Elec. Engng., IEE Proc. E (GB), v. 128, n. 3, p. 107-13.

426. Pitassi, D.A. (1971). "Fast Convolution Using the Walsh Transform", IEEE Trans Electromagn Compat., EMC-13, n 3, p 130-3.

427. Poida, V.N. (1978). "Spectral Analysis in Discrete Orthogonal Bases", "Nauka i Tehnika", Minsk.

428. Polge, R.J., Bhagavan, B.K., Carswell, J.M., McKee, JR. E.R. (1973). "Theory and Implementation of Fast Fourier and Hadamard Transforms", Report # UAH-RR-143, 143p. 143.

429. Poncin, J., Schwarts, P.Y. (1972). "Statistical Properties of Orthogonal Transforms of Images", Ann. Telecommun. (France), v. 27, n. 5-6, 173084.

430. Popov, S.S. (1975). "Evaluating the Elements of Discrete Walsh Transformation", Avtometriya (USSR), n. 1, p. 43-8.

Digital Holography", Northrop Corp Palos Verdes Peninsula Ca. Electronics Div. Corp. Report No. RADC-TR-73-83, p. 88.

. Prasada, G. (1982). "Order and Parameter Identification in Continuous Linear Systems Via Walsh Functions", Proc. IEEE, v 70, n 7, p. 764-6.

. Pratt, W.K. (1971). "Linear and Nonlinear Filtering in the Walsh Domain", Proc. of the 1971 Symposium on Applications of Walsh Functions, p. 38-42.

. Pratt, W.K., Andrews, H.C., Kane, J. (1969). "Hadamard Transform Image Processing", Proc. IEEE, v.57, p. 58-68.

. Pratt, W.K. (1972). "Generalized Wiener Filtering Computation Technique", IEEE Trans. Comput., C-21, p.636-641.

. Ptacek, M. (1979). "Digital Coding of CTV Component Signals Using the Walsh-Hadamard and S-Transformations", Vyzkumny Ustav Rozhlasu A. Televize, Praha, Czech. Slaboproudy Obz. (Czechoslovakia), v 40, n6, p.266-73.

. Qishan, A., Mingrui, Z., Yaokun, L. (1981). "Sequency Division Multiplex System", Int´l Telemetering Conf. (Proc.), v 17, 1981. Publ by Int. Found. for Telem. Woodland Hills, CA; p 1363-1368.

. Radamacher, H., Einige, S. (1922) "Uber Reihen Von Allgemeinen Orthogonal Funtionen", MATH. ANN. 87, 112-138.

439. Ramakrishna, R. P. (1980). "Walsh-Domain in Filtering of Finite Discrete Two-Dimensional Data", 1980 IEEE Intl Symp on Electromagnetic Compatibility 294-6, Baltimore, MD, 407 pp.

440. Rao, G.P., Sivakumar, L. (1981). "Transfer Function Matrix Identification in Mimo Systems via Walsh Functions", Proc. IEEE, v69, n4, p. 465-466.

441. Rao, G.P., Sivakumar, L. (1982). "Piecewise linear system identification via Walsh functions". Int. J. Syst. Sci., v13, n5, p.525-530.

442. Rao, K.R., Narasimhan, M.A., Revuluri, K. (1974). "Image Data Compression by Hadamard-Haar Transform", Proc Natl Electron Conf, v29, Chicago, p. 336-341.

443. Rao, K.R., Narasimhan, M.A., Revuluri, K. (1975). "A Family of Discrete Haar Transforms", Comput. Electrical Eg. 2, p. 367-368.

444. Rao, K.R., Narasimhan, M.A., Revuluri, K. (1975). "Image Data Processing by Hadamard-Haar Transform", IEEE Trans. Comput., C-24, n9, p. 888-896.

445. Rao, K.R., Narasimhan, M.A., Revuluri, K. (1975). "A Family of Discrete Haar Transforms", Comput and Electr. Eng., v 2, n 4, p.367-388.

446. Rao, K.R., Revuluri, K., Narasimhan, M.A., Ahmed, N. (1976). "Complex Haar Transform", IEEE Trans Acoust Speech Signal Process., ASSP-241, n 1, p. 102-104.

447. Rao, K.R., Ahmed, N. (1976). "Orthogonal Transforms for Digital Signal Processing", IEEE Intl. Conf. on Acoustics, Speech and Signal Proc., Philadelphia, p. 136-140.

Narasimhan, M.A. (1978). "Cal-Sal Walsh-Hadamard Transform", IEEE Trans. Acoust., Speech & Signal Process., ASSP-26, p. 605-607.

Rao, K.R., Narasimhan, M.A, Revuluri, K. (1979). "Slant-Haar Transform", Intern. J. Computer Math., Sec. B, 7, p.73-83.

Rao, K.R., Kuo, J.G.K., Narasimhan, M.A. (1979). "Slant-Haar Transform", Int. J. Comput Math (GB), vol. 7, n 1, Journal Paper, p. 73-83.

Rao, G.P., Palanisamy, K.R. (1984). "Analysis of Time-Delay Systems via Walsh Functions", Int. J. Syst. Sci. (GB), v 15, n 1, p. 9-30.

Reck, H. (1979). "Karhunen-Loeve Transformation, A Signal-Processing Method", Nachrichtentech. Elektron (Germany), v 29, n 5, p. 186-8.

Reddy, B.R.K., Siddiqi, M.U., Mullick, S.K. (1983). "Image Data Compression Using Local Behaviour of Haar Transform", J. Inst. Electron & Telecommun. Eng. (India), v 29, n 5 204-10.

Redinbo, R.G. (1971). "Transforms of Generalized Walsh Functions", Proc. IEEE, v 59, n 9, p. 1352-1353.

Redinbo, G.R., Cheung, W. (1980). "Error Protection in the Transmission of Numerical Data", IEEE Int Symp Electromagn Compat, Baltimore, MD, Publ. by IEEE (Cat n 80 CH1538-8EMC), p. 360-365.

Redinbo, G.R., Cheung, W.Y. (1980). "Signal Processing Techniques in Error Control Systems", Rec. IEEE Int Conf Acoust Speech Signal Process ICASSP 80, Proc. vol. 3, Denver, CO, Publ by IEEE (Cat n 80CH1559-4), Piscataway, NJ, p. 968-973.

457. Redinbo, G.R. (1981). "Noise Analysis of Soft Errors in Combinational Digital Circuits via Walsh Transforms", IEEE Trans. Electromagn. Compat., EMC-23, n 4, p. 391-400.

458. Redinbo, G.R., Cheung, W. (1982). "Design and Implementation of Unequal Error-Correcting Coding Systems", IEEE Trans. on Commun., COM-30, n5, p. 1125-1135.

459. Redinbo, G.R., Wang, G.X. (1983). "Probability of Error in Combinational Logic Systems Containing Soft Fails", IEEE Proc Part E, v 130, pt E, n 4, p. 125-137.

460. Reimherr, G.W. (1978). "Walsh Functions (A Bibliography with Abstracts)", Natl Tech. Info. Service, Springfield, LVA, p. 99, Supersedes NTIS/PS-77/0414, NTIS/PS-76/0379, NTIS/PS-75/378, and COM-73-11580.

461. Reschar, N. (1969). "Many-Valued Logic", McGraw-Hill, New York.

462. Robinson, G.S., Granger, R. (1971)."Design Procedure for Nonrecursive Digital Filters Based on Walsh Functions", IEEE Trans. Electromagn. Compat., EMC-16, n3, p. 183-185.

463. Robinson, G.S. (1972). "Logical Convolution and Discrete Walsh and Fourier Power Spectra", IEEE Trans Audio and Electroacoust., Au-20, n 4, p. 271-280.

464. Robinson,, G.S. (1972). "Discrete Walsh Functions and Their Applications", IEEE NATO Adv Study Inst on Network and Signal Theory, England, p. 461-469.

Walsh Functions", IEEE Trans Electromagn Compat, EMC-16, n 3, p. 183-185.

Roddam, T. (1982). "Walsh Functions-Generation and Application", Wireless World (GB), v 88, n 1552, p. 47-9.

Roeser, P.R., Jernigan, M.E. (1982). "Fast Haar Transform Algorithms", IEEE Trans. Comput., C-31, n 2, p. 175-7.

Rosenbloom, J.H. (1971). "Physical Interpretation of Dyadic Groups" Zeek, R.W., Showalter, A.E. (Editors), Proc. of the 1971 Symp. on Applic. of Walsh Functions, p. 158-65.

Roszeitis, D. (1973). "A Programmable Function Generator Based on Walsh Functions", Frequenz (Germany), v 27, n 10, p. 260-5.

Roth, D. (1970). "Special Filters Based on Walsh Functions", Proc Applications of Walsh Functions Symp & Workshop, Washington, DC, p. 12-16.

Roth, D. (1973). "Digital Vielfaltfilter", AEU, ArchElektron Uebertrag: Electron. Commun., v 27, n 2, p. 72-78.

Rubio, A J. (1981). "Note on a New Walsh Transformation Method for Delta Modulated Functions", Signal Proc, v 3, n 3, p. 273-275.

Rubio, A.J. (1983). "A Sequential Logic System for Calculating the Rapid Walsh Transform", Inf. and Autom, v 16, n 56, p. 3-7.

Rubio, A.J. (1983). "Simple Electronic System for computing the Fast Walsh Transform", Int. J. Electron, v 55, n 3, p. 377-383.

475. Rumatowski, K., Sawicki, J. (1975). "On the Accuracy of Filtering Using Special Orthogonal Functions", Proc. of the Symp: Meas. Theory Twente U. of Technol, Enschede, Neth, Publ by Int Meas Conf (IMEKO), Hung., p. 12.

476. Rumatowski, K. (1976). "Non-Recursive Digital Filtering Using Walsh and Haar Transforms", Found. Control Engrg., v 1, n 3, p. 179-195.

477. Rumatowski, K. (1982). "Entwurf Digitaler Nichtrekursiver Filter Mit Hilfe Der Walsh-Transformationen", Z Elektr Energietech, v 12, n 3, p. 233-242.

478. Rumatowski, K. (1976). "Design of Two-Dimensional Nonrecursive Filters Using Walsh Transform", Signal Proc. II: Theories & Applic. Proc. of Eusipco-83 Second European Signal Proc. Conf., Germany, p. 195-198.

479. Salzman, J. (1973). "Discrete Transform Methods in Adaptive Radar Detection", Cal. U. School of Eng. & Applied Science; Rept. No. UCLA-ENG-7331 p. 191.

480. Sannino, M. (1978). "Multiple-Output Walsh Function Generation For Minimum Orthogonality Error", IEEE Trans. Instrum. Meas. IM-27, n 1, p. 29-32.

481. Sarry, A.L. "A Class of Carry-Free and Mixed Operand-Operator Walsh-Type Transforms and Some Applications", Catholic U. America, Washington, DC Univ. Microfilms, Mich. Order No. 75-19536, p. 120.

Spectrum Estimation Using the Haar Functions", Proc. of the IMEKO-Symp. on Problems of Info. Proc. in Meas. Systems 24, Hungary, p. 37.

Scarbata, G. (1973). "Walsh Function Generator", Radio Fernsehen Elektron (Germany), v 22, n 14, p. 470-474.

Scarbata, G. (1976). "Walsh Functions and Their Production", Nachrichtentech. Elektron (Germany), v 26, n 3, p. 111-116.

Schiller, H, Wille, M.J. (1976). "Some Remarks Concerning the Usage of Walsh Transformation in Picture Processing", Deutsche Akademie der Wissenschaftern zu Berlin, (German D.R.) Inst. fuer Hochenergiephysik, p. 29.

Scheller, G. (1976). "Spectral Analysis of Walsh Functions and The Relationship Between Frequency and Sequence Spectra", Nachrichtentech, Elektron (Germany), v 26, n 5, p. 189-91.

Schilling, D.L. (1983). "Investigation of Digital Encoding Techniques for Television Transmission", Natl. Aeronautics and Space Administration, Washington, DC; Rept. No. NAS 1.26:171734; NASA-CR-171734, p. 39.

Schmidt, R.O. (1971). "A Collection of Walsh Analysis Programs", Zeek, R.W.; Showalter, A.e. (Editors) Proc. of the 1971 Symp on Applic. of Walsh Functions 88-94, Washington DC., p. 88-94.

489. Schreiber, H.H. (1970). "Bandwidth Requirements for Walsh", IEEE Trans Inform Theory, IT-16, n 4, p. 91-93.

490. Schreiber, H.H. (1973). "Review of Sequency Multiplexing", Appl of Walsh Funct. Symp, 4th, Proc. Cathol U. of Am. Washington, DC, p. 18-33.

491. Schreiber, H.H. Sandy, G.F. (Eds.), (1974). "Applications of Walsh Functions and Sequency Theory", IEEE, New York.

492. Schreiber, H.H. (1974). "Communications with Walsh Waves", Intl Symp. on Electromagnetic Compatibility, Washington, DC, p. 258-263.

493. Schreiber, H.H. (1975). "Crosstalk in Sequency Division Multiplexing and Switching Systems", IEEE Proc. Natl. Aerosp. Electron. Conf., Dayton, OH, p. 656-663.

494. Schulz, J. (1976). "Application of Walsh Functions to Electronic Function Testing of Digital Systems", Nachrichtentech. Elktron (Germany), v 26, n 12, p. 454-7.

495. Selfridge, R.E. (1955). "Generalized Walsh Transforms", Pacific J. Math. 5, p.451-80.

496. Seseke, K, Moraga, C. (1982). "Chromatic Changes, Liveness and Scaling of Patterns", Proc. of the 6th Intl Conf. on Pattern Recog. Vol. 2 1982 19-22, Germany Publ. IEEE, NY, p. 648-52.

497. Shankar, A.U., Cheng, D.K. (1979). "Noise-Error Determination of Combinational Circuits by Walsh Functions", IEEE Trans. Electromagn, Compat., EMC-21, n 2, p. 146-52.

Function Representation of Shift Registers With Stochastic Inputs", Proc. IEEE, v 67, n 8 p. 1169-70.

Shanks, J.L. (1969). "Computation of the Fast Walsh-Fourier Transform", IEEE Trans. Comput., C-18, n 5, p. 457-9.

Shanks, J. (1969). "Computation of the Fast Walsh-Fourier Transform", Trans. IEEE, ED - 18, p. 457-9.

Shirokov, S.M., Zhukoborskii, V.M. (1975). "Linear Distortion and Crosstalk in a Multichannel Information Transmission System Employing Walsh Function Carriers", Izv. Priborostr. (USSR), v 18, n 5, p. 34-7.

Shore, J.E. (1973). "On the Application of Haar Functions", Naval Research Lab. Washington, DC Rept. No. NRL-7467 4, p. 26.

Shore, J. E. (1973). "Complete Orthonormal Set of Two-Dimensional Haar-Like Functions", Naval Research lab Washington DC; Rept. No. NRL-7471, p. 27.

Shore, J.E. (1973). "A Two-Dimensional Haar-Like Transform", Naval Research Lab Washington, DC; Rept. No. NRL-7472, p. 18.

Shore, J.E. (1973). "On the Application of Haar Functions," IEEE Trans.Com-21, p.209-216.

Siddiqi, M.U., Sinha, V.P. (1977). "Generalized Walsh Functions and Permutation-Invariant Systems", Electromagn Compat. Symp. and Tech. Exhib. 2nd, Montreux, Switz, Publ by IEEE (Cat n 77CH1224-5EMC), NY, p. 43-50.

507. Siddiqi, M.U. (1976). "A Study of Permutation-Invariant Linear Systems", Ph.D. Thesis, Indian Institute of Technology, Kanpur, India.

508. Siddiqi, M.U., Mullick, S.K., Reddy, B.R.K., (1984). "Data Compression Based on Local Dependence Properties of the Kaar Transform", Proc. Int. Workshop on Fault Detection and Spectral Techniques, p. 8.1-8.31.

509. Siemens, K.H., Kitai, R. (1973). "Nonrecursive Equation for the Fourier Transform of a Walsh Function", IEEE Trans. Electromagn. Compat, EMC-15, n2, p. 81-83.

510. Sievers, G.L. (1983). "Robust Estimation Based on Walsh Averages for the General Linear Model", Western Michigan U. Dept. of Math. Rept. No. TR-72, p. 25.

511. Simmons, G.J. (1971). "Correlation Properties of Pseudo-Rademacher-Walsh Codes", IEEE Trans Electromag. Compat., EMC-13, n 3, p 84-7.

512. Singh, R. (1976). "Basic Theory and Applications of Walsh Functions", Stud. J. Inst. Electron. & Telecommun. Eng. (India), v 17, n 1.

513. Sinha, M.S.P., Rajamani, V.S., Sinha, A.K. (1980). "Identification of Non-Linear Distributed System Using Walsh Functions", Int. J. Control 32, n 4, p. 669-676.

514. Sitnikov, O.P., Sukharev, Y.P. (1973). "Principles of Synthesis and Methods for Calculating a Universal Digital-To-Analog Functional Converter Using Fourier-Walsh Series", Kibern and Vychisl. Tekh. (USSR) No. 20, p. 87-99.

Transform to IR Imagery", Army Armament Research and Dev. Command. Dover, NJ; Rept. No. ARSCD-TR-80001; AD-E40c 408, p. 45.
Sivak, G. "The Haar Transform; Its Theory and Computer Implementation", Army Arma. Research and Dev. Command, Dover, NJ; Rept. No. ARSCD-TR-78005; AD-e400, p. 309.
Skwirzynski, J.K. (1975). "New Directions in Signal Processing in Communication and Control", Proc. of the NATO Adv Study Inst on New Dir in Signal Process in Commun & Control, Engl. , Publ by Noordhoff Int. Publ (NATO Adv Study Inst Ser E: Appl Sci, n12),Leiden, Neth, p. 652.
Sloane, E.A. (1980). "Application of Walsh Functions to Converter Testing", Dig of Pap - Test Conf, Test for the 80s, PA; Publ by IEEE (Cat n 80CH1608-9), NJ 1980 p. 81-86.
Sloane, E.A. (1981). "System for Converter Testing Using Walsh Transform Techniques", Digest of Papers, 1981 Intl Test Conf., PA.
Smith, E.G. (1980). "Computer-Aided Design on a PLA-Implemented Fast Walsh-Hadamard Transform Device", Proc. of the 5th Intl Conf. on Pattern Recognition 183-91, Miami, FL., p. 183-91.
Splettstosser, W. (1980). "Error Analysis in The Walsh Sampling Theorem", 1980 IEEE Symp. on Electro.Compatibility,1980,Baltimore, MD; Publ IEEE,NY 407, p. 366-70.

522. Stankovic, R.S., Lukovic, M.M. (1977). "Relations Between Some Systems of Orthogonal Functions", Automatika (Yugo), v 18, n 1-2, p. 30-33.

523. Stankovic, R.S. (1977). "On Haar's and Walsh's Matrices", Automatika (Yugo), v 18, n 3-4, p. 102-107.

524. Stankovic, R.S. (1982). "A Note of the Relation Between Reed-Muller Expansions and Walsh Transforms", IEEE Trans Electromagn Compat, EMC-24, n 1, p. 68-70.

525. Stankovic, M.M., Tosik, Z.L. (1983). "Synthesis of Maitra Cascades by Means of Spectral Coefficients", Proc. IEEE, 130, p.101-8.

526. Starr, G.I. "Synthesis of Discrete-Time Walsh Filters", Cooper Union Adv. Sci. & Arts, NY 139 pp; Avail. U. Microfilms, Ann Arbor, Mich, No. 74-21167.

527. Stavroulakis, P., Tzafestas, S. (1977). "Walsh Series Approach to Observer and Filter Design in Optimal Control Systems", Int J Control, v 26, n 5, p. 721-736.

528. Stavroulakis, P., Tzafestas, S. (1978). "Walsh Series Approach to Time-Delay Control System Observer Design", Int. J. Syst. Sci., v 9, n 3, p. 287-299.

529. Subbayyan, R., Vaitilingam, M.C. (1979). "Walsh Function Approach for Simplification of Linear Systems", Proc. IEEE, v 67, n 12, p. 1676-1678.

"Computer Aided Design of Electronic Circuits Using Single Term Walsh Series", Int J Electron (GB), v 54, n 1, p. 161-165.

Subhash, K. (1974). "Binary Sequences and Redundancy", IEEE Trans Syst. Man and Cybern., SMC-4, n 4, p. 399-401.

Susskind, A.K. (1981). "Testability and Reliability of LSI", Rome Air Dev. Ctr., Griffiss AFB, NY Rept. No. RADC-TR-80-384, p. 128.

Susskind, A.K. (1983). "Testing By Verifying Walsh Coefficients", IEEE Trans. Comput., C-32 n 2, p. 198-201.

Swartwood, R.V. (1972). "A Two-Dimensional Walsh Transform Computer", Air Force Inst of Tech Wright-Patterson AFB Ohio School of Eng.; Rept. No. GE/EE/72-25, p. 83.

Sychev, A.N. (1981). "Adaptive Algorithm for Synthesizing Linear-Threshold Networks", Autom. Control Comput. Sci., v 15 , n 5, p. 13-19.

Tabloski, T.F., Moule, F.J. (1976). "A Numerical Expansion Technique and its Application to Minimal Multiplexer Circuits", Trans. Comput., C-25, p.684-702.

Tadokoro, Y., Higuchi, T. (1977). "New Fourier-Transform Algorithm Using Walsh Functions", IEEE Int. Conf. on Acoust. Speech and Signal Process, Rec, Hartford, Conn, Publ by IEEE (Cat n 77CH1197-3 ASSP), p. 348-351.

538. Takahashi, Y., Marutani, Y., Kitahama, Y. (1978). "Image Synthesis Using 2-Dimensional Walsh Transform System", Trans. Inst. Electron. and Commun. Eng., JPN. Sect. E, v, E61, n 12 10001.

539. Tam, L.D.C., Goulet, R.Y. (1972). "On Arithmetical Shift for Walsh Functions", IEEE Trans. Comput., C-21, n 12, p 1451-1452.

540. Tam. L.D.C., Goulet, R.Y. (1972). "Time-Sequency-Limited Signals in Finite Walsh Transforms", IEEE Trans. Inf. Theory, IT-20, n 2, p.274-276.

541. Tanaka, H. (1972). "Hadamard Transform for Speech Wave Analysis",Stanford U., Cal., Dept. of Computer Science; Rept. No. STAN-CS-307; AI MEMO-175, p. 35.

542. Tatachar, M., Prabhakar, J.C. (1976). "Design of Digital Walsh Filters", IEEE; 1976 Region V. Conference Digest on Elect. Eng. for this Decade 192-3, Austin, Tex., p. 192-3.

543. Tescher, A.G. (1973). "The Role of Phase in Adaptive Image Coding", U. of S. Cal. Image Proc. Inst. Rept. No. USCIPI-510, Thesis, p. 197.

544. Thomas, J.J., Larsen, G.N., Keller, J.M. (1983). "Number of Theoretic Transforms with Independent Length and Moduli", IEEE Trans. Acoust. Speech Signal Process, ASSP-31, n 1, pt 1, p 215-217.

545. Thompson, K.R., Rao, K.R. (1977). "Analyzing A Biorthogonal Information Channel by the Walsh-Hadamard Transform", Comput & Electr. Eng. Vol. 4, No. 2, p. 119-32.

of Analog Circuits and Systems Via Walsh Functions", Tech U. Poland; Tech. Diag. London, Engl, Publ. by Inst. of Meas. and Control, London, Engl. p. 1-10.

Todorow, J. (1981). "Simple Representation of Threshold Functions and the Use of Rademacher-Walsh Transformations in the Synthesis of Threshold Elements", Z. Elektr. Inf. - and Energietech. (Germany), v 11, n 6, p. 563-574.

Todorow, J. (1982). "The Analysis of Switching Functions With The Aid of the Rademacher-Walsh Transformation and Their Representation in the Threshold Algebra", Sektion Informationstechnik, Tech. U. Germany; Z. Elektr. Inf. and Energietech v 12, n 3 261-77.

Todorow, J., Janicke, O. (1983). "The Representation of Multiple-Valued Functions by Series Expansions of Orthogonal Function Systems over Finite Spaces", A. Elektr. Inf. and Energitech (Germany), v 13, n 1, p. 69-80.

Toh-Han Pao, Merat, F.L. (1975). "Distributed Associative Memory for Patterns", IEEE Trans. Syst., Man and Cybern, SMC-5, n 6, p. 612-17.

Tokmen, V.H. (1979). "Some Properties of the Spectra of Ternary Logic Functions", Proc. IEEE 9th Internat. Symp. Multiple-Valued Logic, p.88-93.

Tokmen V.H. (1979). "Evaluation of the Spectrum of Multiple-Valued Logic Networks", Comput. Electric. Engrg 6, p.233-7.

553. Tokmen, V.H. (1980). "Disjoint Decomposability of Multi-Valued Functions by Spectral Means", Proc. IEEE 10th Internat. Symp. Multiple Valued Logic, p.88-93.

554. Tokmen, V.H. (1980). "An Investigation Into The Properties of Multi-Valued Spectral Logic", Ph.D. Thesis, U of Bath, U.K.

555. Tolstykh, G.D. (1973). "Nonlinear Analog-Digital Converters on the Basis of a Walsh Function Spectral Expansion", Trans in: Meas. Tech. v 16, n 4, p. 501-4.

556. Tolstykh, G.D. (1979). "Very Fast Spectral Transformation of Haar Functions", Izv. Vuz Radioelektron (USSR), v 22, n 7, p. 86-9.

557. Toraichi, K., Igarashi, A., Ogawa, A. (1977). "A Note on Several Orthonormal Bases for Digital Signal Processing", Trans. Inst. Electron & Commun. Eng., JPN., Sect E, v E60, n 2, p. 83.

558. Trachtenberg, E.A. (1979). "Fast Wiener Filtering Computation Technique", Proc. 1979 Int. Symp. on the Mathematical Theory of Networks and Systems, v 3, Delf, Holland, p 174-177.

559. Trachtenberg, E.A. (1980). "Construction of Fast Unitary Transforms Which are Equivalent to Karhunen-Loeve Spectral Representations", Proc. 1980 IEEE Int. Symp. on Electromagn. Compet., Baltimore, p 376-379.

560. Trachtenberg, E.A. (1983). "Systems over Finite Groups as Suboptimal Wiener Filters: A Comparative Study", Proc. 1983 Int. Symp. on Math. Theory of Systems and Networks, Beer-Sheva, Israel.

for Signals in the Form of Walsh functions", Radiotekhnika, Moskva (USSR), v 28, n 10, p. 42-6.
Trakhtman, A.M., Trakhtman, V.A. (1973). "The Frequency of Walsh Functions", Trans in: Telecommuni. & Radio Eng., Pt. 2, v 28, n 12, p. 56-8.
Trakhtman, A.M. (1974). "Fundamentals of the Linear Theory of Signals and Systems Defined on a Finite Set of Points". Avtom. & Telemekh (USSR) v 35, n 4, p 81-92., Trans. Autom. and Remote Control Vol. 35 No. 4, p. 589-99.
Trakhtman, V.A. (1976). "Fast Fourier Transform for a Wide Class of Systems of Orthogonal Functions." Trans. in: Radio Eng. & Electron. Phys. v 21, n 5, p. 90-6.
Trappl, R., Horn, W., Rappelsberger, P. (1982). "Fast Walsh versus Fast Fourier Transform: A Comparison in the Analysis of Seizure EEG", Prog. in Cybernetics and Systems Research, v 9. Publ by Hemisphere Publ Corp., USA and England, p. 97-102.
Trushkin, A.V. (1979). "Efficient Fast Walsh Transform Algorithm with Memory Location Retention", Trans in Radio Eng. & Electron. Phys., v 24, n 5, p. 45-9.
Tsipours, P., LSteele, C., Costello, T. (1980) "Fast Unitary Transforms - Benefits and Restrictions", Bedford Research Associates, MA, Rept. No. Scientific-3, AFGL-TR-81-0060, p. 14.
Tzafestas, S., Frangakis, G., Pimenidis, T. (1976). "Global Walsh Function Generators", Electron. Engeg. 48, p.45-9.

569. Tzafestas, S.G. (1983). "Walsh Transform Theory and Its Application to Systems Analysis and Control: An Overview", Math & Comput. Simulation (Netherlands), v 25, n 3, p. 214-25.

570. Tzidon, A., Berger, I., Yoelli, M. (1978). "A Practical Approach to Fault Detection in Combinational Networks", IEEE Trans. Comput., C-27, p.968-71.

571. Uesaka, Y. (1969). "Construction of Nonlinear Discriminant Functions of Many-Valued Patterns", Trans in: Electron. and Commun. JAP (USA), v 52, n 12, p. 146-55.

572. Ulman, L.J. (1970). "Computation of the Hadamard Transform and the R-Transform in Ordered Form", IEEE Trans. Comput., C-19, n 4, p. 359-60.

573. Van Cleave, J. (1970). "Walsh Preprocessor", Electronic Labs. Inc, PA; Rome Air Dev. Ctr.; Rept. No. AEL-10492-4200; RADC-TR-80-253, p 70.

574. Van Till, J.W.J. (1973). "Comments on 'On the Defenition and Generation of Walsh Functions'", IEEE Trans. Comput., C-22, n 7, p. 702-3.

575. Venkatesam, S., Prasada Rao, G. (1979). "Walsh Spectral Analyser", Int. J. Electron, v 46, n 4, p. 413-415.

576. Venkateswarlu, Y., Reddy, D.C. (1975). "A Review of Walsh Function in Communicationg, J. Inst. Eng. (India) Electron. & Telecommun. Eng. Div., v 55, n ET2-3, p. 91-5.

Communication by Use of Orthogonal Signal Correlation and Walsh Functions", Los Alamos Scientific Lab., N. Mex, p 12, Journal Ann. GRAI7515.

- Wadbrook, D.G., Woolons, D.S. (1972). "Implementation of 2-Dimensional Walsh Transforms for Pattern Recognition", Electron Lett. (GB), v 8, n 5 134-6.
- Wajs, K. (1976). "The Walsh Functions and their Application in Electrotechnics", Przegl. Elektrotech. (Poland), v 52, n 11 413-18.
- Wallis, J.S. (1972). "Hadamard Matrices", Lecture Notes No. 292, Springer-Verlag, N.Y.
- Walmsley, W.M. (1971). "Walsh Functions, Transforms and their Applications", Electron Eng (Lond), v 46, n 556, p 63, 65, 67-68.
- Walsh, D.M. (1971). "Design Considerations for Digital Walsh Filters", IEEE Fall Electron Conf, Proc., Illinois, p 372-7.
- Walsh, J.L. (1923). "A Closed Set of Orthogonal Functions", Amer. J. Math., 45, p.5-24.
- Wang, Zhong De. (1982). "New Algorithms for the Slant Transformation", IEEE Trans Pattern Anal Mach Intell, v PAMI-4, No 5, p 511-555.
- Wendling, S., Stamon, G. (1976). "Hadamard and Haar Transforms and their Power Spectra in Character Recognition", IEEE Joint Workshop on Pattern Recognition and Artificial Intelligence p 103-12.

587. Wendling, S., Gagneux, G., Stamon, G. (1976). "Use of the Haar Transform and Some of its Properties in Character Recognition", Proc. Internat. Joint Conf. Pattern Recognition, Colorado, USA, p.844-8.

588. Wendling, S. et al. (1978). " A Set of Invariants within the Power Spectra of Unitary Transforms", IEEE Trans. Comput., C-27, p 1213-1216.

589. Werz, J., Garger, W. (1975) "Spectral Modelling of Frequency and Sequencing Systems". Mess. Steuern Begin MIT Auto. (Germany), v 18, n 11, 394-5.

590. Werz, J. (1977). "Applications of the Fast Walsh Transform in Filter Calculations". Mess. Steuern Regeln MIT Automatisierungsprax (Germany), v 20, n 1, p. 15-16.

591. Whiteman, A.L. (1973). "An Infinite Family of Hadamard Matrices of Williamson Type", J. Combinatorial Theory, Ser. A 14, p.334-40.

592. Wong, K.M., Jan, Y.G. `(19x3). "Adaptive Walsh Equaliser for Data Transmission", IEEE Proc. Part F, v 130, n 2, Part F, p 153-160.

593. Yang, S., Feng, T. (1976). "An Approach of Developing Fast Transform Algorithms", Syracuse U. NY Dept of Elec. & Comp. Eng. Rept. No. RADC-R-76-92, p 136.

594. Yip, P. C. (1976). "Zoom Walsh Transform". IEEE Trans. Electromagn. Compat., EMC-18, n.2, p. 334-40.

Correlation for Generalized Discrete Transforms", IEEE Trans. Electromagn. Compat., EMC-24, n.1, p. 64-68.

. Yodokawa, E. (1971). "Some Notes on the Walsh Functions", Electron Commun Japan, v 54, n 12, p 134-136.

. Yolles, M.I., Smith, E.H., Walmsley, W.M. (1982). "Walsh Theory and Spectral Analysis of Engineering Surfaces", Wear (Switzerland) v83, n1, p.151-64, 2nd Intl Comf. on Metrology & Prop. of Eng. Surfaces 14-16, England.

. Yuen, C.K. (1971). "Walsh Functions and Gray Code." IEEE Trans. Electromagn. Compat., EMC-13, n.3, p. 68-73.

. Yuen, C.K. (1971) "New Walsh-function Generator", Electron. Let. (GB), v 7, n 20, p. 605-7.

. Yuen, C.K. (1972). "Comments on ´Application of Walsh Transform to Statistical Analysis´". IEEE Trans. Syst., Man and Cybern, SMC-2, n 2, p. 294.

. Yuen, C.K. (1972). "Walsh Functions for the Computer". 5th Aust. Compu. Conf. Abstracts oNly 53, 22-26. Brisbane, Australia, Publ. Australian Computer Soc. Inc., Watson, Australia, p. 84.

. Yuen, C.K. (1972). "High-Sequency Walsh-Function Generation". Electron. Lett. (GB), v 8, n 17, p. 450-2.

. Yuen, C.K. (1973). "Comments on ´a Hazard-Free Walsh-Function Generator´". IEEE Trans. Instrum. Meas., IM-22, n 1, p. 99-100.

604. Yuen, C.K. (1973). "On Dyadic Invariant Systems". Proc Inst. Radio Elect. Eng, Australia, v 34, n.5, p. 166-169.

605. Yuen, C.K. (1975). Algorithm for Computing the Correlation Functions of Walsh functions", IEEE Trans. Electromagn. Compat., EMC-17, n.3, p.177-180.

606. Yuen, C.K. (1975). "A Theorem on the Cyclic Correlations of Walsh Functions". IEEE Trans. Comput., C-24, n 10, p. 1028-9.

607. Yuen, C.K., Edwards, C.R. (1976). Comments on the Application of the Rademacher-Walsh Transform to Boolean Function Classification and Threshold Logic Synthesis", IEEE Trans. Comput., C-25, n 7, p. 766-7.

608. Yuen, C.K. (1977). "Testing Random Number Generators by Walsh Transform", IEEE Trans. Comput., C-26, n.4, p.329-333.

609. Zagajewski, T. (1978). "Logic Operations on Walsh Functions and Some of Their Applications", Bull. Acad. Pol. Sci. Ser. Sci. Tech. (Poland), v 26, n 8-9 795-800.

610. Zagajewski, T. (1980). "Walsh Functions in the Analysis of Flip-Flop Performance", Bull Acad Pol Sci, Ser Sci Tech, v 28, n 11-12 p 645-652.

611. Zeek, R.W., Showalter, A.E. (1971). "Applications of Walsh Functions. 1971 Proc. of the Symp. Held at The Dept. Auditorium, Const. Ave. Washington, D.C. on 13, 14, 15 Sec. Edition", Naval Res. Lab. Washington DC; Prepared in Coop. With Maryland U., College Park and the Electro. Compatibiltiy Group of the IEEE.

of Walsh Functions. 1972 Proc. of the Symp. (3RDO Held at the Catho. U. of Am. Washington, D.C. on 27,28 and 29 March", Naval Res. Lab. Washington D.C. 411p - Prepared in coop. with Electro. Group of the IEE.

Zeek, R.W., Showalter, A.E. (1973). "Applications of Walsh Functions. 1973 Proc. of the Symp. (4th Held at thef Catho. U. of Am., Washington D.C. on 16,17,18 April", Naval Res. Lab Washington D.C. 1973 309 p - Prepared in coop. with the Electro. Group of the IEEE.

Zeek, R.W., Showalter, A.E. (1973). "Applications of Walsh Functions, 4th Symp. Proceedings 1973", Nav. Res. Lab, Washington D.C., Available from NTIS (AD-763 000), Springfield, VA 1973 298 p.

Zhang, G., (1983). "Parameter Spectrum in Spectral Multiple-Valued Logic Design", Electron. Lett. (GB), v 19, n 6 199-200.

Zhinhua, L; Zhang, Q., (1983). "Ordering of Walsh Functions", IEEE Trans. Electromagn. Compat., EMC-25 n 2, p155-199.

Zhong-De Wang, (1982). "New Algorithm for the Slant Transform", IEEE Trans. Pattern Anal. and Mach. Intell., v PAMI-4, n 5 551-5.

Zhuravin, L.G., Ivanov, V.M., Semenov, E.I., (1980). "Application of the Orthogonal Walsh Transformation to the Group Discrete Representation of Noncorrelated Random Processes Ensemble", Izv. Vuz. Priborostr. (USSR), v 23, n 11, p 3-11.