FOURIER ANALYSIS ON FINITE GROUPS WITH APPLICATIONS IN SIGNAL PROCESSING AND SYSTEM DESIGN

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Preface

We believe that the group-theoretic approach to spectral techniques and, in particular, Fourier analysis, has many advantages, for instance, the possibility for a unified treatment of various seemingly unrelated classes of signals. This approach allows to extend the powerful methods of classical Fourier analysis to signals that are defined on very different algebraic structures that reflect the properties of the modelled phenomenon.

Spectral methods that are based on finite Abelian groups play a very important role in many applications in signal processing and logic design. In recent years the interest in developing methods that are based on Finite non-Abelian groups has been steadily growing, and already, there are many examples of cases where the spectral methods based only on Abelian groups do not provide the best performance.

This monograph reviews research by the authors in the area of abstract harmonic analysis on finite non-Abelian groups. Many of the results discussed have already appeared in somewhat different forms in journals and conference proceedings.

We have aimed for presenting the results here in a consistent and self-contained way, with a uniform notation and avoiding repetition of well-known results from abstract harmonic analysis, except when needed for derivation, discussion and appreciation of the results. However, the results are accompanied, where necessary or appropriate, with a short discussion including comments concerning their relationship to the existing results in the area.

The purpose of this monograph is to provide a basis for further study in abstract harmonic analysis on finite Abelian and non-Abelian groups and its applications.

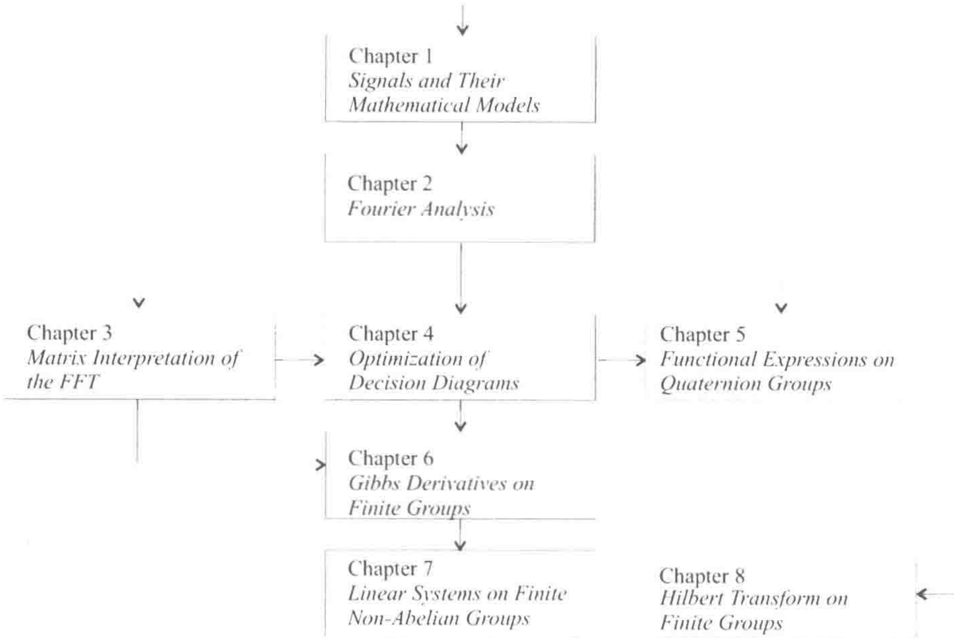

Fig. 0.1 Relationships among the chapters.

The monograph will hopefully stimulate new research that results in new methods and techniques to process signals modelled by functions on finite non-Abelian groups.

Fig. 0.1 shows relationships among the chapters.

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Prof. Mark G. Karpovsky and Prof. Lazar A. Trachtenberg have traced in a series of publications chief directions in research in Fourier analysis on finite non-Abelian groups. We are following these directions in our research in the area, in particular in extending the theory of Gibbs differentiation to non-Abelian structures. For that, we are very indebted to them both.

The first author is very grateful to Prof. Paul L. Butzer, Dr. J. Edmund Gibbs, and Prof. Tsutomu Sasao for continuous support in studying and research work.

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R.S.S., C.M, J.T.A.

Acronyms

ACDD	Arithmetic transform decision diagram
BDD	Binary decision diagram
BDT	Binary decision tree
DD	Decision diagram
DT	Decision tree
DFT	Discrete Fourier transform
FFT	Fast Fourier transform
FDD	Functional decision diagram
FNADD	Fourier decision diagram on finite non-Abelian groups
FNADT	Fourier decision tree on finite non-Abelian groups
FNAPDD	Fourier decision diagram on finite non-Abelian groups with preprocessing
FNAPDT	Fourier decision tree on finite non-Abelian groups with preprocessing
KDD	Kronecker decision diagram
mvMTDD	Matrix-valued multi-terminal decision diagram
MTBDD	Multi-terminal binary decision diagram
MTBDT	Multi-terminal binary decision tree
MDD	Multiple-place diagram
MTDD	Multi-terminal decision diagram
MTDT	Multi-terminal decision tree
nvMTDD	Number-valued multi-terminal decision diagram
PKDD	Pseudo-Kronecker decision diagram
QDD	Quaternary decision diagrams
SBDD	Shared binary decision diagrams
TVFG	Two-variable function generator
WDD	Walsh decision diagram

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