

Contents

1. Introduction to Signals and Systems

- Mathematical representation of signals
- Discrete signal models
- Fundamentals of system analysis

2. Fourier Analysis on Finite Groups

- Basics of finite group theory
- Representation theory of finite groups
- Fourier transforms on finite groups
- Abelian and non-abelian groups
- Spectral decomposition techniques
- Fast Fourier Transform (FFT) on finite groups

3. Matrix Representation and Fast Algorithms

- Matrix formulations of Fourier transforms
- Efficient FFT implementations
- Computational complexity analysis
- Recursive and structured algorithms

4. Fourier Decision Diagrams and System Design

- Decision diagrams for discrete functions
- Fourier-based representations
- Optimization techniques
- Applications in digital circuit design
- Logic synthesis and system implementation

5. Functional Expansions on Quaternion and Dyadic Groups

- Quaternion groups
- Walsh–Fourier expansions
- Haar and arithmetic transforms
- Fixed-polarity polynomial representations
- Fast spectral coefficient computation

6. Gibbs Derivatives on Finite Groups

- Definition and theoretical foundations
- Partial Gibbs derivatives
- Discrete differential equations
- Computational methods and algorithms

7. Linear Systems on Non-Abelian Groups

- Shift-invariant systems
- Spectral characterization
- System analysis using group-theoretic methods
- Applications in signal processing

8. Hilbert Transform on Finite Groups

- Theoretical framework
- Extensions to non-abelian groups
- Applications in discrete signal analysis

9. Applications and Future Directions

- Signal processing applications
- Digital system design
- Computational and engineering perspectives