
R. Tolimieri · M. An · C. Lu

**Mathematics of
Multidimensional Fourier
Transform Algorithms**



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Mathematics Of Multidimensional Fourier Transform Algorithms

Vijay Madisetti



Mathematics Of Multidimensional Fourier Transform Algorithms:

Mathematics of Multidimensional Fourier Transform Algorithms Richard Tolimieri, Myoung An, Chao Lu, 2012-12-06 Fourier transforms of large multidimensional data sets arise in many fields ranging from seismology to medical imaging The rapidly increasing power of computer chips the increased availability of vector and array processors and the increasing size of the data sets to be analyzed make it both possible and necessary to analyze the data more than one dimension at a time The increased freedom provided by multidimensional processing however also places intensive demands on the communication aspects of the computation making it difficult to write code that takes all the algorithmic possibilities into account and matches these to the target architecture This book develops algorithms for multi dimensional Fourier transforms that yield highly efficient code on a variety of vector and parallel computers By emphasizing the unified basis for the many approaches to one dimensional and multidimensional Fourier transforms this book not only clarifies the fundamental similarities but also shows how to exploit the differences in optimizing implementations This book will be of interest not only to applied mathematicians and computer scientists but also to seismologists high energy physicists crystallographers and electrical engineers working on signal and image processing Topics covered include tensor products and the fast Fourier transform finite Abelian groups and their Fourier transforms Cooley Tukey and Good Thomas algorithms lines and planes reduced transform algorithms field algorithms implementation on Risc and parallel *Mathematics of Multidimensional Fourier Transform Algorithms* Richard Tolimieri, Myoung An, Chao Lu, 1993 The main emphasis of this book is the development of algorithms for processing multi dimensional digital signals and particularly algorithms for multi dimensional Fourier transforms in a form that is convenient for writing highly efficient code on a variety of vector and parallel computers

Mathematics of Multidimensional Fourier Transform Algorithms Richard Tolimieri, Myoung An, Chao Lu, 1993

Fast Fourier Transform and Convolution Algorithms H.J. Nussbaumer, 2013-03-08 This book presents in a unified way the various fast algorithms that are used for the implementation of digital filters and the evaluation of discrete Fourier transforms The book consists of eight chapters The first two chapters are devoted to background information and to introductory material on number theory and polynomial algebra This section is limited to the basic concepts as they apply to other parts of the book Thus we have restricted our discussion of number theory to congruences primitive roots quadratic residues and to the properties of Mersenne and Fermat numbers The section on polynomial algebra deals primarily with the divisibility and congruence properties of polynomials and with algebraic computational complexity The rest of the book is focused directly on fast digital filtering and discrete Fourier transform algorithms We have attempted to present these techniques in a unified way by using polynomial algebra as extensively as possible This objective has led us to reformulate many of the algorithms which are discussed in the book It has been our experience that such a presentation serves to clarify the relationship between the algorithms and often provides clues to improved computation techniques

Chapter 3 reviews the fast digital filtering algorithms with emphasis on algebraic methods and on the evaluation of one dimensional circular convolutions Chapters 4 and 5 present the fast Fourier transform and the Winograd Fourier transform algorithm

Fast Fourier Transform and Convolution Algorithms Henri J Nussbaumer,1982-09-01 **Fast Fourier Transforms** C. Sidney Burrus,2012-11-30 This book uses an index map a polynomial decomposition an operator factorization and a conversion to a filter to develop a very general and efficient description of fast algorithms to calculate the discrete Fourier transform DFT The work of Winograd is outlined chapters by Selesnick Pueschel and Johnson are included and computer programs are provided

Fast Algorithms for Signal Processing Richard E. Blahut,2010-06-24 Efficient signal processing algorithms are important for embedded and power limited applications since by reducing the number of computations power consumption can be reduced significantly Similarly efficient algorithms are also critical to very large scale applications such as video processing and four dimensional medical imaging This self contained guide the only one of its kind enables engineers to find the optimum fast algorithm for a specific application It presents a broad range of computationally efficient algorithms describes their structure and implementation and compares their relative strengths for given problems All the necessary background mathematics is included and theorems are rigorously proved so all the information needed to learn and apply the techniques is provided in one convenient guide With this practical reference researchers and practitioners in electrical engineering applied mathematics and computer science can reduce power dissipation for low end applications of signal processing and extend the reach of high end applications

Twentieth Century Harmonic Analysis J.S. Byrnes,2012-12-06 Almost a century ago harmonic analysis entered a still continuing Golden Age with the emergence of many great masters throughout Europe They created a wealth of profound analytic methods to be successfully exploited and further developed by succeeding generations This flourishing of harmonic analysis is today as lively as ever as the papers presented here demonstrate In addition to its own ongoing internal development and its basic role in other areas of mathematics physics and chemistry financial analysis medicine and biological signal processing harmonic analysis has made fundamental contributions to essentially all twentieth century technology based human endeavours including telephone radio television radar sonar satellite communications medical imaging the Internet and multimedia This ubiquitous nature of the subject is amply illustrated The book not only promotes the infusion of new mathematical tools into applied harmonic analysis but also to fuel the development of applied mathematics by providing opportunities for young engineers mathematicians and other scientists to learn more about problem areas in today s technology that might benefit from new mathematical insights

Introduction To Algorithms Thomas H Cormen,Charles E Leiserson,Ronald L Rivest,Clifford Stein,2001 An extensively revised edition of a mathematically rigorous yet accessible introduction to algorithms

Transforms and Fast Algorithms for Signal Analysis and Representations Guoan Bi,Yonghong Zeng,2003-10-21 This book is a comprehensive presentation of recent results and developments on several widely used

transforms and their fast algorithms In many cases new options are provided for improved or new fast algorithms some of which are not well known in the digital signal processing community The book is suitable as a textbook for senior undergraduate and graduate courses in digital signal processing It may also serve as an excellent self study reference for electrical engineers and applied mathematicians whose work is related to the fields of electronics signal processing image and speech processing or digital design and communication

Multidimensional Discrete Unitary Transforms Artyom M. Grigoryan, Sos S. Aghaian, 2003-07-31 This reference presents a more efficient flexible and manageable approach to unitary transform calculation and examines novel concepts in the design classification and management of fast algorithms for different transforms in one two and multidimensional cases Illustrating methods to construct new unitary transforms for best algorithm selection

Advances in Electronics and Electron Physics, 1991-10-11 Advances in Electronics and Electron Physics

Digital Signal Processing Fundamentals Vijay Madisetti, 2017-12-19 Now available in a three volume set this updated and expanded edition of the bestselling The Digital Signal Processing Handbook continues to provide the engineering community with authoritative coverage of the fundamental and specialized aspects of information bearing signals in digital form Encompassing essential background material technical details standards and software the second edition reflects cutting edge information on signal processing algorithms and protocols related to speech audio multimedia and video processing technology associated with standards ranging from WiMax to MP3 audio low power high performance DSPs color image processing and chips on video Drawing on the experience of leading engineers researchers and scholars the three volume set contains 29 new chapters that address multimedia and Internet technologies tomography radar systems architecture standards and future applications in speech acoustics video radar and telecommunications Emphasizing theoretical concepts Digital Signal Processing Fundamentals provides comprehensive coverage of the basic foundations of DSP and includes the following parts Signals and Systems Signal Representation and Quantization Fourier Transforms Digital Filtering Statistical Signal Processing Adaptive Filtering Inverse Problems and Signal Reconstruction and Time Frequency and Multirate Signal Processing

Fast Fourier Transform Algorithms for Parallel Computers Daisuke Takahashi, 2019-10-05 Following an introduction to the basis of the fast Fourier transform FFT this book focuses on the implementation details on FFT for parallel computers FFT is an efficient implementation of the discrete Fourier transform DFT and is widely used for many applications in engineering science and mathematics Presenting many algorithms in pseudo code and a complexity analysis this book offers a valuable reference guide for graduate students engineers and scientists in the field who wish to apply FFT to large scale problems Parallel computation is becoming indispensable in solving the large scale problems increasingly arising in a wide range of applications The performance of parallel supercomputers is steadily improving and it is expected that a massively parallel system with hundreds of thousands of compute nodes equipped with multi core processors and accelerators will be available in the near future Accordingly the book also provides up to date

computational techniques relevant to the FFT in state of the art parallel computers Following the introductory chapter Chapter 2 introduces readers to the DFT and the basic idea of the FFT Chapter 3 explains mixed radix FFT algorithms while Chapter 4 describes split radix FFT algorithms Chapter 5 explains multi dimensional FFT algorithms Chapter 6 presents high performance FFT algorithms and Chapter 7 addresses parallel FFT algorithms for shared memory parallel computers In closing Chapter 8 describes parallel FFT algorithms for distributed memory parallel computers

ICASSP 90: Multidimensional signal processing ,1990 **Digital Signal Processing System and Its Realization** Yan-Zhong Zhang,Yufen Yao,1993 *Information, Science, and Technology in a Quantum World* ,2002 *Mathematical Reviews* ,1998

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