

Nasser Kehtarnavaz · Abhishek Sehgal · Shane Parris ·
Arian Azarang

Smartphone-Based Real-Time Digital Signal Processing

Third Edition

Smartphone Based Real Time Digital Signal Processing

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Smartphone Based Real Time Digital Signal Processing:

Smartphone-Based Real-Time Digital Signal Processing, Second Edition Nasser Kehtarnavaz, Abhishek Sehgal, Shane Parris, 2018-12-17 Real time or applied digital signal processing courses are offered as follow ups to conventional or theory oriented digital signal processing courses in many engineering programs for the purpose of teaching students the technical know how for putting signal processing algorithms or theory into practical use These courses normally involve access to a teaching laboratory that is equipped with hardware boards in particular DSP boards together with their supporting software A number of textbooks have been written discussing how to achieve real time implementation on these hardware boards This book discusses how to use smartphones as hardware boards for real time implementation of signal processing algorithms as an alternative to the hardware boards that are used in signal processing laboratory courses The fact that mobile devices in particular smartphones have become powerful processing platforms led to the development of this book enabling students to use their own smartphones to run signal processing algorithms in real time considering that these days nearly all students possess smartphones Changing the hardware platforms that are currently used in applied or real time signal processing courses to smartphones creates a truly mobile laboratory experience or environment for students In addition it relieves the cost burden associated with using dedicated signal processing boards noting that the software development tools for smartphones are free of charge and are well maintained by smartphone manufacturers This book is written in such a way that it can be used as a textbook for real time or applied digital signal processing courses offered at many universities Ten lab experiments that are commonly encountered in such courses are covered in the book This book is written primarily for those who are already familiar with signal processing concepts and are interested in their real time and practical aspects Similar to existing real time courses knowledge of C programming is assumed This book can also be used as a self study guide for those who wish to become familiar with signal processing app development on either Android or iPhone smartphones

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considering that these days nearly all students possess smartphones Changing the hardware platforms that are currently used in applied or real time signal processing courses to smartphones creates a truly flexible laboratory experience or environment for students In addition it relieves the cost burden associated with using dedicated signal processing boards noting that the software development tools for smartphones are free of charge and are well maintained by smartphone manufacturers This book is written in such a way that it can be used as a textbook for real time or applied digital signal processing courses offered at many universities Ten lab experiments that are commonly encountered in such courses are covered in the book It is written primarily for those who are already familiar with signal processing concepts and are interested in their real time and practical aspects Similar to existing real time courses knowledge of C programming is assumed This book can also be used as a self study guide for those who wish to become familiar with signal processing app development on either Android or iOS smartphones tablets

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Kehtarnavaz,2022-05-31 Real time or applied digital signal processing courses are offered as follow ups to conventional or theory oriented digital signal processing courses in many engineering programs for the purpose of teaching students the technical know how for putting signal processing algorithms or theory into practical use These courses normally involve access to a teaching laboratory that is equipped with hardware boards in particular DSP boards together with their supporting software A number of textbooks have been written discussing how to achieve real time implementation on these hardware boards This book discusses how to use smartphones as hardware boards for real time implementation of signal processing algorithms thus providing an alternative to the hardware boards that are used in signal processing laboratory courses The fact that mobile devices in particular smartphones have become powerful processing platforms led to the development of this book to enable students to use their own smartphones to run signal processing algorithms in real time considering that these days nearly all students possess smartphones Changing the hardware platforms that are currently used in applied or real time signal processing courses to smartphones creates a truly flexible laboratory experience or environment for students In addition it relieves the cost burden associated with using dedicated signal processing boards noting that the software development tools for smartphones are free of charge and are well maintained by smartphone manufacturers This book is written in such a way that it can be used as a textbook for real time or applied digital signal processing courses offered at many universities Ten lab experiments that are commonly encountered in such courses are covered in the book It is written primarily for those who are already familiar with signal processing concepts and are interested in their real time and practical aspects Similar to existing real time courses knowledge of C programming is assumed This book can also be used as a self study guide for those who wish to become familiar with signal processing app development on either Android or iOS smartphones tablets

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Compressive Vision for Surveillance Applications Henry Braun,Pavan Turaga,Andreas Spanias,Sameeksha Katoch,Suren Jayasuriya,Cihan Tepedelenlioglu,2022-05-31 Compressed sensing CS allows signals and images to be reliably inferred from undersampled measurements Exploiting CS allows the creation of new types of high performance sensors including infrared cameras and magnetic resonance imaging systems Advances in computer vision and deep learning have enabled new applications of automated systems In this book we introduce reconstruction free compressive vision where image processing and computer vision algorithms are embedded directly in the compressive domain without the need for first reconstructing the measurements into images or video Reconstruction of CS images is computationally expensive and adds to system complexity Therefore reconstruction free compressive vision is an appealing alternative particularly for power aware systems and bandwidth limited applications that do not have on board post processing computational capabilities Engineers must balance maintaining algorithm performance while minimizing both the number of measurements needed and the computational requirements of the algorithms Our study explores the intersection of compressed sensing and computer vision with the focus on applications in surveillance and autonomous navigation Other applications are also discussed at the end and a comprehensive list of references including survey papers are given for further reading **Signals and Systems**

Khalid Sayood,2022-06-01 This book is designed for use as a textbook for a one semester Signals and Systems class It is sufficiently user friendly to be used for self study as well It begins with a gentle introduction to the idea of abstraction by looking at numbers the one highly abstract concept we use all the time It then introduces some special functions that are useful for analyzing signals and systems It then spends some time discussing some of the properties of systems the goal being to introduce the idea of a linear time invariant system which is the focus of the rest of the book Fourier series discrete and continuous time Fourier transforms are introduced as tools for the analysis of signals The concepts of sampling and modulation which are very much a part of everyday life are discussed as applications of the these tools Laplace transform

and Z transform are then introduced as tools to analyze systems The notions of stability of systems and feedback are analyzed using these tools The book is divided into thirty bite sized modules Each module also links up with a video lecture through a QR code in each module The video lectures are approximately thirty minutes long There are a set of self study questions at the end of each module along with answers to help the reader reinforce the concepts in the module

Linear Algebra for Pattern Processing Kenichi Kanatani, 2022-06-01 Linear algebra is one of the most basic foundations of a wide range of scientific domains and most textbooks of linear algebra are written by mathematicians However this book is specifically intended to students and researchers of pattern information processing analyzing signals such as images and exploring computer vision and computer graphics applications The author himself is a researcher of this domain Such pattern information processing deals with a large amount of data which are represented by high dimensional vectors and matrices There the role of linear algebra is not merely numerical computation of large scale vectors and matrices In fact data processing is usually accompanied with geometric interpretation For example we can think of one data set being orthogonal to another and define a distance between them or invoke geometric relationships such as projecting some data onto some space Such geometric concepts not only help us mentally visualize abstract high dimensional spaces in intuitive terms but also lead us to find what kind of processing is appropriate for what kind of goals First we take up the concept of projection of linear spaces and describe spectral decomposition singular value decomposition and pseudoinverse in terms of projection As their applications we discuss least squares solutions of simultaneous linear equations and covariance matrices of probability distributions of vector random variables that are not necessarily positive definite We also discuss fitting subspaces to point data and factorizing matrices in high dimensions in relation to motion image analysis Finally we introduce a computer vision application of reconstructing the 3D location of a point from three camera views to illustrate the role of linear algebra in dealing with data with noise This book is expected to help students and researchers of pattern information processing deepen the geometric understanding of linear algebra

Machine and Deep Learning Algorithms and Applications Uday Shankar Shanthamallu, Andreas Spanias, 2022-05-31 This book introduces basic machine learning concepts and applications for a broad audience that includes students faculty and industry practitioners We begin by describing how machine learning provides capabilities to computers and embedded systems to learn from data A typical machine learning algorithm involves training and generally the performance of a machine learning model improves with more training data Deep learning is a sub area of machine learning that involves extensive use of layers of artificial neural networks typically trained on massive amounts of data Machine and deep learning methods are often used in contemporary data science tasks to address the growing data sets and detect cluster and classify data patterns Although machine learning commercial interest has grown relatively recently the roots of machine learning go back to decades ago We note that nearly all organizations including industry government defense and health are using machine learning to address a variety of needs and applications The

machine learning paradigms presented can be broadly divided into the following three categories supervised learning unsupervised learning and semi supervised learning Supervised learning algorithms focus on learning a mapping function and they are trained with supervision on labeled data Supervised learning is further sub divided into classification and regression algorithms Unsupervised learning typically does not have access to ground truth and often the goal is to learn or uncover the hidden pattern in the data Through semi supervised learning one can effectively utilize a large volume of unlabeled data and a limited amount of labeled data to improve machine learning model performances Deep learning and neural networks are also covered in this book Deep neural networks have attracted a lot of interest during the last ten years due to the availability of graphics processing units GPU computational power big data and new software platforms They have strong capabilities in terms of learning complex mapping functions for different types of data We organize the book as follows The book starts by introducing concepts in supervised unsupervised and semi supervised learning Several algorithms and their inner workings are presented within these three categories We then continue with a brief introduction to artificial neural network algorithms and their properties In addition we cover an array of applications and provide extensive bibliography The book ends with a summary of the key machine learning concepts

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