Giulio Coluccia Chiara Ravazzi Enrico Magli

Compressed Sensing for Distributed Systems



Matteo Testa, Diego Valsesia, Tiziano Bianchi, Enrico Magli

Compressed Sensing for Distributed Systems Giulio Coluccia, Chiara Ravazzi, Enrico Magli, 2015-05-29 This book presents a survey of the state of the art in the exciting and timely topic of compressed sensing for distributed systems It has to be noted that while compressed sensing has been studied for some time now its distributed applications are relatively new Remarkably such applications are ideally suited to exploit all the benefits that compressed sensing can provide The objective of this book is to provide the reader with a comprehensive survey of this topic from the basic concepts to different classes of centralized and distributed reconstruction algorithms as well as a comparison of these techniques This book collects different contributions on these aspects It presents the underlying theory in a complete and unified way for the first time presenting various signal models and their use cases It contains a theoretical part collecting latest results in rate distortion analysis of distributed compressed sensing as well as practical implementations of algorithms obtaining performance close to the theoretical bounds It presents and discusses various distributed reconstruction algorithms summarizing the theoretical reconstruction guarantees and providing a comparative analysis of their performance and complexity In summary this book will allow the reader to get started in the field of distributed compressed sensing from theory to practice We believe that this book can find a broad audience among researchers scientists or engineers with very diverse backgrounds having interests in mathematical optimization network systems graph theoretical methods linear systems stochastic systems and randomized algorithms To help the reader become familiar with the theory and algorithms presented accompanying software is made available on the authors web site implementing several of the algorithms described in the book The only background required of the reader is a good knowledge of advanced calculus and linear algebra Compressed Sensing for Privacy-preserving Data Processing Matteo Testa, Diego Valsesia, Tiziano Bianchi, Enrico Magli, 2019 The objective of this book is to provide the reader with a comprehensive survey of the topic compressed sensing in information retrieval and signal detection with privacy preserving functionality without compromising the performance of the embedding in terms of accuracy or computational efficiency The reader is guided in exploring the topic by first establishing a shared knowledge about compressed sensing and how it is used nowadays Then clear models and definitions for its use as a cryptosystem and a privacy preserving embedding are laid down before tackling state of the art results for both applications. The reader will conclude the book having learned that the current results in terms of security of compressed techniques allow it to be a very promising solution to many practical problems of interest The book caters to a broad audience among researchers scientists or engineers with very diverse backgrounds having interests in security cryptography and privacy in information retrieval systems Accompanying software is made available on the authors website to reproduce the experiments and techniques presented in the book The only background required to the reader is a good knowledge of linear algebra probability and information theory Greedy Algorithms for Distributed Compressed Sensing ,2014 Sensor Fusion and its Applications

Ciza Thomas, 2010-08-16 This book aims to explore the latest practices and research works in the area of sensor fusion The book intends to provide a collection of novel ideas theories and solutions related to the research areas in the field of sensor fusion This book is a unique comprehensive and up to date resource for sensor fusion systems designers This book is appropriate for use as an upper division undergraduate or graduate level text book It should also be of interest to researchers who need to process and interpret the sensor data in most scientific and engineering fields The initial chapters in this book provide a general overview of sensor fusion The later chapters focus mostly on the applications of sensor fusion Much of this work has been published in refereed journals and conference proceedings and these papers have been modified and edited for content and style With contributions from the world's leading fusion researchers and academicians this book has 22 chapters covering the fundamental theory and cutting edge developments that are driving this field Network Compressive Sensing Guangtao Xue, Yi-Chao Chen, Feng Lyu, Minglu Li, 2022-10-23 This book investigates compressive sensing techniques to provide a robust and general framework for network data analytics The goal is to introduce a compressive sensing framework for missing data interpolation anomaly detection data segmentation and activity recognition and to demonstrate its benefits Chapter 1 introduces compressive sensing including its definition limitation and how it supports different network analysis applications Chapter 2 demonstrates the feasibility of compressive sensing in network analytics the authors we apply it to detect anomalies in the customer care call dataset from a Tier 1 ISP in the United States A regression based model is applied to find the relationship between calls and events The authors illustrate that compressive sensing is effective in identifying important factors and can leverage the low rank structure and temporal stability to improve the detection accuracy Chapter 3 discusses that there are several challenges in applying compressive sensing to real world data Understanding the reasons behind the challenges is important for designing methods and mitigating their impact The authors analyze a wide range of real world traces The analysis demonstrates that there are different factors that contribute to the violation of the low rank property in real data In particular the authors find that 1 noise errors and anomalies and 2 asynchrony in the time and frequency domains lead to network induced ambiguity and can easily cause low rank matrices to become higher ranked To address the problem of noise errors and anomalies in Chap 4 the authors propose a robust compressive sensing technique It explicitly accounts for anomalies by decomposing real world data represented in matrix form into a low rank matrix a sparse anomaly matrix an error term and a small noise matrix Chapter 5 addresses the problem of lack of synchronization and the authors propose a data driven synchronization algorithm It can eliminate misalignment while taking into account the heterogeneity of real world data in both time and frequency domains The data driven synchronization can be applied to any compressive sensing technique and is general to any real world data The authors illustrates that the combination of the two techniques can reduce the ranks of real world data improve the effectiveness of compressive sensing and have a wide range of applications The networks are constantly generating a wealth

of rich and diverse information This information creates exciting opportunities for network analysis and provides insight into the complex interactions between network entities However network analysis often faces the problems of 1 under constrained where there is too little data due to feasibility and cost issues in collecting data or 2 over constrained where there is too much data so the analysis becomes unscalable Compressive sensing is an effective technique to solve both problems It utilizes the underlying data structure for analysis Specifically to solve the under constrained problem compressive sensing technologies can be applied to reconstruct the missing elements or predict the future data Also to solve the over constraint problem compressive sensing technologies can be applied to identify significant elements To support compressive sensing in network data analysis a robust and general framework is needed to support diverse applications Yet this can be challenging for real world data where noise anomalies and lack of synchronization are common First the number of unknowns for network analysis can be much larger than the number of measurements For example traffic engineering requires knowing the complete traffic matrix between all source and destination pairs in order to properly configure traffic and avoid congestion However measuring the flow between all source and destination pairs is very expensive or even infeasible Reconstructing data from a small number of measurements is an underconstrained problem In addition real world data is complex and heterogeneous and often violate the low level assumptions required by existing compressive sensing techniques These violations significantly reduce the applicability and effectiveness of existing compressive sensing methods Third synchronization of network data reduces the data ranks and increases spatial locality However periodic time series exhibit not only misalignment but also different frequencies which makes it difficult to synchronize data in the time and frequency domains The primary audience for this book is data engineers analysts and researchers who need to deal with big data with missing anomalous and synchronization problems Advanced level students focused on compressive sensing techniques will also benefit from this book as a reference Compressive Sensing for Wireless Networks Zhu Han, Husheng Li, Wotao Yin, 2013-06-06 This comprehensive reference delivers the understanding and skills needed to take advantage of compressive sensing in wireless networks Networked Sensing Information and Control Venkatesh Saligrama, 2007-10-23 Recent advances in sensor and computing technologies provide the impetus for deploying distributed sensing systems Distributed networks are envisioned to provide real time information in such diverse applications as building safety environmental monitoring power systems manufacturing as well as military and space applications While significant research and development effort over the last decade in sensor development physical layer transmission and networking infrastructure has laid the initial groundwork for practical deployment realization of such distributed sensing systems is still in its infancy The principle challenges from a systems level perspective arise due to the difficulty in realizing the objectives of inferencing and control tasks for a distributed dynamical environment through an underlying power bandwidth constrained ad hoc networked infrastructure The main challenge can be summarized as follows How to make decisions under uncertainty which

arises from spatially distributed dynamic information when sharing distributed data is limited by networking constraints The book presents research on informational and mathematical aspects of networked sensing systems. The importance and timeliness of the book is evidenced by the explosion of several independent special sessions devoted to specific aspects of sensor networks in reputed international conferences Despite these efforts the focus has been on specific and isolated aspects of networked sensing and there is a need for cross disciplinary efforts to integrate ideas from the various research communities The book presents research work conducted by internationally reputed researchers from control information theory and signal processing focused on the common theme of distributed sensing inferencing and control over networks On account of the contemporaneous nature of the topic we have no doubt that there will significant interest evinced by the both the research and industrial community at large Compressive Sensing Based Algorithms for Electronic Defence Amit Kumar Mishra, Ryno Strauss Verster, 2016-12-22 This book details some of the major developments in the implementation of compressive sensing in radio applications for electronic defense and warfare communication use It provides a comprehensive background to the subject and at the same time describes some novel algorithms It also investigates application value and performance related parameters of compressive sensing in scenarios such as direction finding spectrum monitoring detection and classification Compressive Sensing for Wireless Communication Radha Sankararajan, Hemalatha Rajendran, Aasha Nandhini Sukumaran, 2022-09-01 Compressed Sensing CS is a promising method that recovers the sparse and compressible signals from severely under sampled measurements CS can be applied to wireless communication to enhance its capabilities As this technology is proliferating it is possible to explore its need and benefits for emerging applicationsCompressive Sensing for Wireless Communication provides A clear insight into the basics of compressed sensing A thorough exploration of applying CS to audio image and computer vision Different dimensions of applying CS in Cognitive radio networks CS in wireless sensor network for spatial compression and projection Real world problems projects that can be implemented and tested Efficient methods to sample and reconstruct the images in resource constrained WMSN environmentThis book provides the details of CS and its associated applications in a thorough manner It lays a direction for students and new engineers and prepares them for developing new tasks within the field of CS It is an indispensable companion for practicing Blind Compressed Sensing Sivan Gleichman, Tekhniyon, engineers who wish to learn about the emerging areas of interest Makhon tekhnologi le-Yiśra'el. Fakultah le-handasat hashmal, 2010

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# Table of Contents Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering

- 1. Understanding the eBook Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - The Rise of Digital Reading Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Advantages of eBooks Over Traditional Books
- 2. Identifying Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - User-Friendly Interface
- 4. Exploring eBook Recommendations from Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Personalized Recommendations
  - Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering User

- **Reviews and Ratings**
- Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering and Bestseller Lists
- 5. Accessing Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering Free and Paid eBooks
  - Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering Public Domain eBooks
  - Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering eBook Subscription Services
  - Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering Budget-Friendly Options
- 6. Navigating Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering eBook Formats
  - ∘ ePub, PDF, MOBI, and More
  - Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering Compatibility with Devices
  - Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Highlighting and Note-Taking Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Interactive Elements Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
- 8. Staying Engaged with Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Compressed Sensing For Distributed Systems Springerbriefs In Electrical And

Computer Engineering

- 9. Balancing eBooks and Physical Books Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Setting Reading Goals Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - o Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Fact-Checking eBook Content of Compressed Sensing For Distributed Systems Springerbriefs In Electrical And Computer Engineering
  - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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