When Compressive Sensing Meets Mobile Crowdsensing

Linghe Kong · Bowen Wang ·
Guihai Chen

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Linghe Kong
Department of Computer Science
and Engineering
Shanghai Jiao Tong University
Shanghai, China

Guihai Chen
Department of Computer Science
Nanjing University
Nanjing, China

Bowen Wang
ByteDance Ltd.
Beijing, China

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Preface

"I would recommend strongly this valuable and impactful monograph to researchers who are interested in the frontier of data management in mobile crowdsensing."

—Prof. Laurence Tianruo Yang
St Francis Xavier University, Canada
Fellow of the Canadian Academy of Engineering

"An valuable book brings together systematic Compressive Sensing with Mobile Crowdsensing and shows a promising possible future direction."

—Prof. Meikang Qiu
Columbia University, USA

"This monograph presents strategic insights for data quality challenge in mobile crowdsensing by leveraging compressive sensing. I would sincerely invite you to read and comment this book."

—Prof. Jinjun Chen
Swinburne University of Technology, Australia

Mobile crowdsensing, as an emerging sensing paradigm, enables the masses to join in data collection tasks using powerful mobile devices. However, date mobile crowdsensing platforms have yet to be widely adopted in practice. The major concern is the quality of the data collected by mobile crowdsensing. There are numerous causes: some locations may generate redundant data, while others may not be covered at all, since the participators are usually not systematically coordinated; privacy is a concern for some people, who don't wish to share their real-time locations, and therefore some key information may be missing; and some participants may upload fake data to fraudulently gain rewards. When compressive sensing meets mobile crowdsensing, these problematic aspects are gradually addressed.

This book provides a comprehensive introduction to applying compressive sensing to improve data quality in mobile crowdsensing. It covers the following topics: missing data reconstruction, fault data detection, data privacy preservation, multidimensional data conversion, and efficient task allocation.

Missing data is common in the mobile crowdsensing because the movements of participators are uncontrolled and some locations lack participators for sensing. From this book, readers can learn how to use the compressive sensing method to reconstruct the missing data, in which the essential compressive sensing is an effective solution to accurately recover a sparse signal using very few samples.

Faulty data is another data quality problem in mobile crowdsensing caused by unstable sensors and unreliable wireless transmissions. Especially, when missing data and faulty data coexist in practical crowdsensing, the problem becomes more intractable. To solve this problem, this book presents an extended compressive sensing method, namely iterative compressive sensing. By iteratively running compressive sensing and time series, the problem of missing value reconstruction and faulty data detection are decoupled.

In order to dispel participators' worry on privacy leakage, compressive sensing also shows its value. A homogeneous compressive sensing framework is introduced, which encrypts the data for privacy issues while maintaining the homomorphic obfuscation property for compressive sensing.

In some complicated mobile sensing scenarios, the collected data are multidimensional. The conventional compressive sensing cannot be directly utilized on such multidimensional data. This book introduces a converted compressive sensing method to convert the data structure, so that the compressive sensing can still be applied for data quality improvement.

Other than improving the quality of collected data, compressive sensing also facilitates the data collecting process in task allocation. We observe that more allocated tasks indicate higher data quality and higher cost in most mobile crowdsensing. Based on this observation, this book presents a compressive crowdsensing framework to reduce the cost by minimizing the number of allocated tasks, while guaranteeing the data quality.

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Linghe Kong
Bowen Wang
Guihai Chen

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