

Preface

Nonnegative Matrix Factorization (NMF) is one of the widely used matrix factorization techniques for revealing hidden factors that underlie sets of random variables, measurements, or signals. NMF is essentially a method for extracting individual signals from mixtures of signals. The concept of a matrix factorization arises in a variety of significant applications and each matrix factorization task makes a different assumption regarding factor matrices and their underlying configurations. Therefore choosing the appropriate one is important in each application domain. In most instances, the data to be analyzed are nonnegative, and sometimes they also have sparse representations. For such applications, it is preferable to take these constraints into account in the analysis to extract nonnegative and sparse/smooth components or factors with physical meaning or reasonable interpretation, and thereby avoid absurd or unpredictable results. NMF research can be motivated by the open problems and continuing research on these problems, and hence a need to edit this book to report the latest results on the topic. These challenges motivate further research in the area of NMF, and this book intends to put together all the innovative ideas and new results in this research area.

This book aims to disseminate timely to the scientific community the new developments in NMF spanning from theoretical frameworks, algorithmic developments, to a variety of applications. I believe that a potential impact of the NMF and its extensions on scientific advancements might be as great as the other popular matrix factorization techniques such as Independent Component Analysis (ICA) or the Singular Value Decomposition (SVD) and Principal Component Analysis (PCA). In contrast to ICA or SVD/PCA approaches, NMF technique, if successfully realized may improve interpretability and visualization of large-scale data while maintaining the physical feasibility more closely.

The book provides a wide coverage of the models and algorithms for NMF both from a theoretical and a practical point of view. It also covers some emerging techniques in NMF, especially those developed recently, offering academic researchers and practitioners a comprehensive update about the new development in this field. The book provides a forum for researchers to exchange their ideas and to

foster a better understanding of the state of the art of the subject. I envisage that the publication of this book will stimulate new ideas and more cutting-edge research activities in this area.

This book is intended for computer science and electronics engineers (researchers and graduate students) who wish to get novel research ideas and some training in NMF, sparse component analysis, machine learning, artificial intelligence, and signal processing applications. Furthermore, the research results previously scattered in many scientific articles worldwide are methodically collected and presented in the book in a unified form. As a result of its twofold character the book is likely to be of interest to researchers, engineers, and graduates who wish to learn the core principles, methods, algorithms, and applications of NMF.

I would like to thank the authors for their excellent submissions (chapters) to this book, and their significant contributions to the review process which have helped to ensure high quality of this publication. Without their contributions, it would have not been possible for the book to come successfully into existence. In addition, my special thanks to Ms. Lu Yang and Ms. Jessie Guo from Springer Beijing for their kind support and great efforts in bringing the book to fruition.

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