

UNSUPERVISED
ADAPTIVE FILTERING

Volume I: Blind Source Separation

ADAPTIVE AND LEARNING SYSTEMS FOR SIGNAL PROCESSING, COMMUNICATIONS, AND CONTROL

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UNSUPERVISED ADAPTIVE FILTERING

Volume I: Blind Source Separation

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McMaster University



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PREFACE

In 1994 I edited a book on “blind deconvolution,” which presented an account of the various algorithms that had been developed essentially for solving the blind channel-equalization problem. The material presented in that book spanned a period of over 25 years, going back to the pioneering work of Robert Lucky in 1966 on the decision-directed mode of operating the least-mean-square algorithm and that of Y. Sato in 1975 on a blind channel-equalization algorithm that bears his name. These two pioneering contributions were followed by another pioneering contribution to blind channel equalization, namely, the constant-modulus algorithm that was developed independently by Godard in 1980 and Treichler and Agee in 1983. Subsequently, it was recognized that these three blind equalization algorithms are members of the family of Bussgang algorithms

In 1994 Pierre Comon published a paper in a signal-processing journal on “independent component analysis,” which was followed by Tony Bell and Terry Sejnowski’s 1995 paper in a neural computation journal on the Infomax (or, more precisely, the maximum-entropy) algorithm for blind signal separation. Although, indeed, work on the blind signal-separation problem could be traced to a much earlier paper by J. Herault, C. Jutten, and B. Ans that was published in 1985, it would be fair to say that Pierre Comon’s paper and that of Tony Bell and Terry Sejnowski served as catalysts for raising the profile of research interests in blind source separation to the extent that the subject has become a “hot” area with potential applications in a variety of diverse fields.

Despite the fact that blind channel equalization and blind source separation have originated in their own somewhat independent ways, they are in actual fact intimately related to each other. Indeed, they constitute the two pillars of unsupervised adaptive filtering. By bringing them together under the umbrella of this new book, organized in two volumes, not only have we provided an up-to-date treatment of blind signal-separation and blind channel-equalization algorithms and their underlying theoretical formalisms but also opened an avenue for the cross-fertilization of new ideas. Volume I of the book covers blind source-separation algorithms, and Volume II covers blind deconvolution (i.e., blind equalization) and its relationship to blind source separation.

xvi PREFACE

I would like to take this opportunity to express my deep gratitude to each and every one of my coauthors for making the writing of this unique two-volume work a reality.

SIMON HAYKIN

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March 2000*