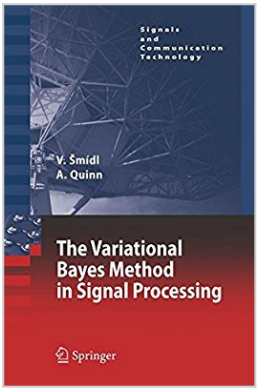

The Variational Bayes Method in Signal Processing (Signals and Communication Technology)

By Václav Šmídl, Anthony Quinn

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Gaussian linear modelling cannot address current signal processing demands. In moderncontexts,suchasIndependentComponentAnalysis(ICA),progresshasbeen made speci?cally by imposing non-Gaussian and/or non-linear assumptions. Hence, standard Wiener and Kalman theories no longer enjoy their traditional hegemony in the ?eld, revealing the standard computational engines for these problems. In their place, diverse principles have been explored, leading to a consequent diversity in the implied computational algorithms. The traditional on-line and data-intensive pre- cupations of signal processing continue to demand that these algorithms be tractable. Increasingly, full probability modelling (the so-called Bayesian approach)-or partial probability modelling using the likelihood function-is the pathway for - sign of these algorithms. However, the results are often intractable, and so the area of distributional approximation is of increasing relevance in signal processing. The Expectation-Maximization (EM) algorithm and Laplace approximation, for ex- ple, are standard approaches to handling dif?cult models, but these approximations (certainty equivalence, and Gaussian, respectively) are often too drastic to handle the high-dimensional, multi-modal and/or strongly correlated problems that are - countered. Since the 1990s, stochastic simulation methods have come to dominate Bayesian signal processing. Markov Chain Monte Carlo (MCMC) sampling, and - lated methods, are appreciated for their ability to simulate possibly high-dimensional distributions to arbitrary levels of accuracy. More recently, the particle ?ltering - proach has addressed on-line stochastic simulation. Nevertheless, the wider acce- ability of these methods-and, to some extent, Bayesian signal processing itself- has been undermined by the large computational demands they typically make.

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The Variational Bayes Method in Signal Processing (Signals and Communication Technology) By Václav Šmídl, Anthony Quinn Bibliography

- Sales Rank: #5245451 in Books
- Brand: Brand: Springer
- Published on: 2005-12-16
- Original language: English
- Number of items: 1
- Dimensions: 9.21" h x .63" w x 6.14" l, 1.09 pounds
- Binding: Hardcover
- 228 pages

Editorial Review

From the Back Cover

This is the first book-length treatment of the Variational Bayes (VB) approximation in signal processing. It has been written as a self-contained, self-learning guide for academic and industrial research groups in signal processing, data analysis, machine learning, identification and control. It reviews the VB distributional approximation, showing that tractable algorithms for parametric model identification can be generated in off-line and on-line contexts. Many of the principles are first illustrated via easy-to-follow scalar decomposition problems. In later chapters, successful applications are found in factor analysis for medical image sequences, mixture model identification and speech reconstruction. Results with simulated and real data are presented in detail. The unique development of an eight-step "VB method", which can be followed in all cases, enables the reader to develop a VB inference algorithm from the ground up, for their own particular signal or image model.

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