

Statistics > Applications

# A Variational Bayes Approach to **Decoding in a Phase-Uncertain Digital Receiver**

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(Submitted on 4 Jul 2011)

This paper presents a Bayesian approach to symbol and phase inference in a phase-unsynchronized digital receiver. It primarily extends [Quinn 2011] to the multi-symbol case, using the variational Bayes (VB) approximation to deal with the combinatorial complexity of the phase inference in this case. The work provides a fully Bayesian extension of the EM-based framework underlying current turbo-synchronization methods, since it induces a von Mises prior on the time-invariant phase parmeter. As a result, we achieve tractable iterative algorithms with improved robustness in low SNR regimes, compared to the current EM-based approaches. As a corollary to our analysis we also discover the importance of prior regularization in elegantly tackling the significant problem of phase ambiguity.

6 pages, 3 figures, Accepted at the Irish Signals and Comments: Systems Conference 23-24 June 2011 **Applications (stat.AP)**; Machine Learning (stat.ML) Subjects: MSC classes: 62C10, 62F15, 94A12, 62H30 ACM classes: 1.5.4 Cite as: arXiv:1107.0662 [stat.AP] (or arXiv:1107.0662v1 [stat.AP] for this version)

#### Submission history

From: Arijit Das [view email] [v1] Mon, 4 Jul 2011 15:37:19 GMT (38kb,BD)

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