Gaussian Process Regression with a Student-t Likelihood

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(Submitted on 22 Jun 2011)

This paper considers the robust and efficient implementation of Gaussian process regression with a Student-t observation model. The challenge with the Student-t model is the analytically intractable inference which is why several approximative methods have been proposed. The expectation propagation (EP) has been found to be a very accurate method in many empirical studies but the convergence of the EP is known to be problematic with models containing non-log-concave site functions such as the Student-t distribution. In this paper we illustrate the situations where the standard EP fails to converge and review different modifications and alternative algorithms for improving the convergence. We demonstrate that convergence problems may occur during the type-II maximum a posteriori (MAP) estimation of the hyperparameters and show that the standard EP may not converge in the MAP values in some difficult cases. We present a robust implementation which relies primarily on parallel EP updates and utilizes a moment-matching-based double-loop algorithm with adaptively selected step size in difficult cases. The predictive performance of the EP is compared to the Laplace, variational Bayes, and Markov chain Monte Carlo approximations.

Subjects:	**Machine Learning (stat.ML)**; Methodology (stat.ME)
Journal reference:	Journal of Machine Learning Research 12 (2011) 3227-3257
Cite as:	**arXiv:1106.4431 [stat.ML]**
	(or **arXiv:1106.4431v1 [stat.ML]** for this version)

Submission history

From: Pasi Jylänki M. Sc. [view email]
[v1] Wed, 22 Jun 2011 12:24:03 GMT (373kb)

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