VBEM algorithm for the log gaussian cox process

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

The log Gaussian Cox process is a spatial model for count data with a hidden layer of Gaussian variables. In ecology, it is well adapted to model maps of species with spatial interaction. Classically, the Bayesian estimation of the log Gaussian Cox process is performed by a MCMC approach. Estimates are asymptotically of good quality but, in practice, MCMC approaches can lead to time consuming algorithms. This can be a limit when a large number of estimation steps are required, like in model selection for multiple species.

We propose here a faster algorithm based on a variational principle: the Variational Bayesian Expectation Maximization algorithm (VBEM). Since we are not in the situation of a conjugate exponential model, the variational distribution of the parameters and the hidden Gaussian field do not have tractable form. Neither the E step nor the M step can be easily performed. In VBEM, the variational distribution used to approximate the joint a posteriori distribution is in the family of distributions assuming independence between hidden variables and parameters. For the log Gaussian Cox process, we propose to consider a restriction of this family by assuming a mean field factorisation for the hidden variables distribution. Then estimates of the variational parameters are obtained using Monte-Carlo simulations.

Experiments on simulated data, in the case of an exponential covariance function, show that the proposed VBEM algorithm is as efficient (except for the estimation of the covariance parameter) and much faster than a MCMC algorithm from the literature.

This work illustrates how variational and simulation-based approaches can nicely combine to exploit the best of each and lead to efficient EM-like algorithms.