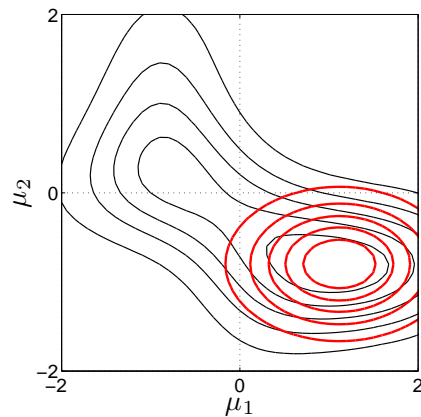
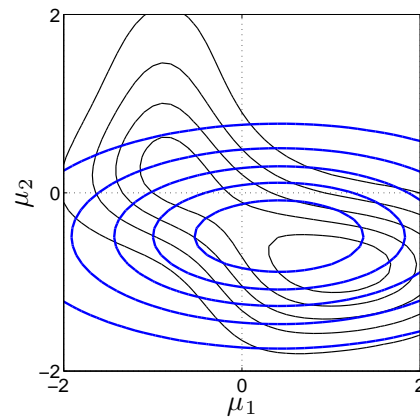


Improving on Expectation Propagation

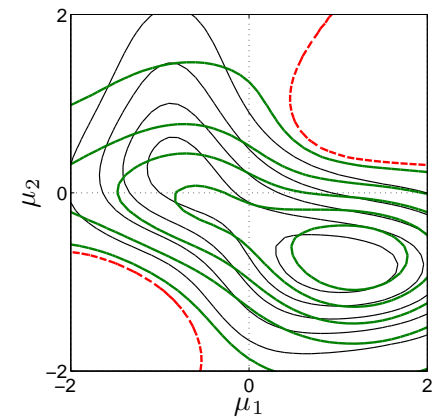
Ulrich Paquet, Ole Winther, Manfred Opper



$p(\theta|\mathcal{D})$ and VB $q(\theta)$



$p(\theta|\mathcal{D})$ and EP (EC) $q(\theta)$



EP + 1st order correction

- Use exponential family $q(\theta)$ as surrogate for $p(\theta|\mathcal{D})$ (in a Bayesian context).
- Moment-matching between $q(\theta)$ and all $q_n(\theta)$, where

$$q_n(\theta) \propto \text{factor } n \times \text{cavity distribution} .$$

- Express **exact** posterior and marginal likelihood in terms of “small parameters” $\varepsilon_n(\theta) = (q_n(\theta) - q(\theta)) / q(\theta)$:

$$p(\theta|\mathcal{D}) = \frac{1}{R} q(\theta) \prod_n (1 + \varepsilon_n(\theta)) \quad \text{and} \quad Z = Z_{\text{EP}} R, \quad \text{where} \quad R = \int d\theta q(\theta) \prod_n (1 + \varepsilon_n(\theta)) .$$

- Use expansion

$$\prod_n (1 + \varepsilon_n(\theta)) = \left(1 + \sum_n \varepsilon_n(\theta) + \sum_{n_1 < n_2} \varepsilon_{n_1}(\theta) \varepsilon_{n_2}(\theta) + \dots \right)$$

to various orders.