Multilinear Gaussian Process

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Motivation

Bilinear model: $y[t] = f[t] \cdot g[t] + e[t]$

Objective *Estimate each component from the data.*

Bilinear GP

Assumption

- White Gaussian noise $e[t] \sim \mathcal{N}(0, \sigma^2)$
- Independent GP models $f \sim \mathcal{N}(0, K_\alpha), g \sim \mathcal{N}(0, K_\beta)$

Marginal likelihood $L(\theta) = \log \mathrm{p}(y|X, \alpha, \beta)$

Expectation Maximization+Gibbs sampling

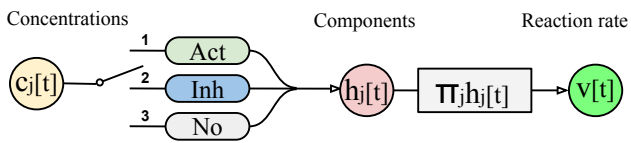
E step:

$$Q^{(k)}(\alpha, \beta) = \iint \log \mathrm{p}(y, g, f|\alpha, \beta)\mathrm{p}(g, f|y, \alpha_k, \beta_k) df\, dg$$

M step:

$$\alpha_{k+1}, \beta_{k+1} = \arg\max_{\alpha,\beta} Q^{(k)}(\alpha, \beta)$$

Application: bio-kinetics selection



- **Act**: activation effect.
- **Inh**: inhibition effect.
- **No**: no effect.

Important results

We are able to

- estimate each component in the bilinear model,
- estimate the noise variance σ^2,
- extend the method to multilinear cases.