Muon counting 1: The reversible jump approach

Balázs Kégl

LAL, CNRS/Université Paris Sud

SIMINOLE meeting

Telecom ParisTech, October 25, 2010

MCMC setup

- "Slow" MCMC of nuisance variables
- (Non-adaptive) MCMC of "global" variables and L_μs and t_μs (no energy dependence yet)
- Reversible jump MCMC [Green '95] for handling mixed (continuous/discrete) tracklength distribution
- Reversible jump MCMC for counting muons and gamma photons

MCMC setup

- Reversible jump MCMC [Green '95]
  - "virtual" variables (or degrees of freedom) $\mathbf{u}$
  - such that $(\mathbf{y}, \mathbf{u}) \leftrightarrow \mathbf{y}_{\text{candidate}}$
  - the likelihood-ratio becomes

$$\underbrace{\frac{p(\mathbf{x}|\mathbf{y}_{\text{candidate}})}{p(\mathbf{x}|\mathbf{y})}}_{\text{likelihood}} \times \underbrace{\frac{p(\mathbf{y}_{\text{candidate}})(K_\mu+1)!}{p(\mathbf{y})K_\mu!}}_{\text{prior}} \times \underbrace{\frac{P_{\text{remove}}}{P_{\text{add}}(K_\mu+1)p(\mathbf{u})}}_{\text{proposal}} \times \underbrace{\left|\frac{\partial\left(L_\mu^{(K_\mu+1)}, t_\mu^{(K_\mu+1)}\right)}{\partial\mathbf{u}}\right|}_{\text{Jacobian}}$$

  - Hand-tuned proposals (prior for t_μ, exponential $\ll$ prior for L_μ)

MCMC setup

- Good results but very slow convergence

- I would still like to try it with adaptive MCMC, but the identification problem must be solved

  - $+$ adaptive proposals?

- The main bottleneck is the handling of the gamma photons: small photons should be grouped together into one complex component

  - probably together with small muons $\rightarrow$ censoring