

# 基于Unscented卡尔曼滤波器的信号转导通路参数与不可观测状态估计

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系统生物学的一个主要目的是建立细胞信号转导通路的数学模型。然而细胞信号转导通路多具有较强非线性、参与生化反应物质多等特点，同时测量数据往往不完备，并且混有来自实验各个阶段的各种噪声，这些都给模型参数估计带来很大困难。该文采用Unscented卡尔曼滤波器估计信号转导通路未知参数与模型不可观测状态。以肿瘤坏死因子诱导的核转录因子 $\kappa$ B信号转导通路为例进行了仿真，结果表明，采用该方法可以在噪声干扰下较准确地估计系统未知参数和不能观测状态。

## Estimate Parameters and Unobservable States of Signalling Pathways with Unscented Kalman Filter

One object of systems biology is to develop the mathematical models of biochemical networks in cell and to analysis the system dynamic properties based on these models as well as to predict the system output. However, strong nonlinearity, complexity, noisy and incomplete measurements make the parameter estimation more difficult. In this paper, Unscented Kalman filter was proposed to estimate the unknown parameters and the unobservable state variables simultaneously. TNF $\alpha$  mediated NF- $\kappa$ B signal transduction pathway was taken as an example to illustrate the effectiveness of the method. Simulation results are encouraging and show that both parameters and unobservable state variables can be estimated well.

### 关键词

系统生物学(Systems biology); Unscented卡尔曼滤波器(Unscented Kalman Filter); 参数估计(parameter estimation); NF- $\kappa$ B 信号转导通路(NF- $\kappa$ B signaling pathway)