

Regularization of Gene Regulatory Networks Perturbed by White Noise

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Abstract : Mathematical models of gene regulatory networks can in many cases be described by ordinary differential equations with switching nonlinearities, where the initial value problem is ill-posed. Several regularization methods are known in the case of deterministic networks, but the presence of stochastic noise leads to several technical difficulties. In the presentation, it is proposed to apply the methods of the stochastic singular perturbation theory going back to Yu. Kabanov and Yu. Pergamentshchikov. This approach is used to regularize the above ill-posed problem, which, e.g., makes it possible to design stable numerical schemes. Several examples are provided in the presentation, which support the efficiency of the suggested analysis. The method can also be of interest in other fields of biomathematics, where differential equations contain switchings, e.g., in neural field models.

Keywords : ill-posed problems, singular perturbation analysis, stochastic differential equations, switching nonlinearities

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