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Asymptotic convergence study of a PIDE model for gene regulatory networks.

The low copy number species involved in gene expression makes its behaviour inherently stochastic. In order to capture this stochastic nature of the system, we use a Partial Integro Differential Equation (PIDE) as a continuous approximation of a Chemical Master Equation (CME). While the CME solution is unavailable in the most cases, the PIDE model admits an analytical solution for its steady state for networks involving only one gene. Thanks to the existence of this analytic solution, we are able to prove the exponential convergence to equilibrium of the 1D PIDE. The conservation of this property for networks involving more than one gene (multidimensional PIDE) is successfully tested via numerical simulation.