Title:	PROPAGATION OF EXTRINSIC PERTURBATION IN MULTISTEP BIOCHEMICAL PATHWAYS
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Abstract:	Biochemical pathways that underlie all cellular processes are inter-connected chemical reactions forming intricate networks of functional and physical interactions between molecular species in the cell. Much of regulation in these pathways are through negative and positive feedback processes. Many of the steps in a multi- step pathway are subjected to different environmental milieu as they take place at different cellular compartments. It is thus important to study, how such an interacting dynamical system faithfully transmits signals in spite of different types of perturbations act at different steps of the pathway. To study this we consider a minimal model of a three-step biochemical pathway comprising of two feedback loops — one negative and one positive — in the form of common cellular control processes in cells. This activator-inhibitor pathway is known to exhibit different types of simple and complex dynamics (equilibrium, periodic, biorhythmic, chaos) on variations in parameters. We delineate the qualitative and quantitative changes in the pathway dynamics for constant (bias) and random external perturbations acting on the pathway steps locally, or globally to all steps. We show that random fluctuations merely cause quantitative variations in the concentrations of the different variables, but bias induces qualitative change in dynamics of the pathway. These perturbations also are transmitted differentially when applied at different steps of the pathway. Thus, the dynamic response of multi-step biochemical path- ways to external perturbations depends on their stoichiometry, network topology and, most non-intuitively, on the pathway dynamics.
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