STOCHASTICALLY SWITCHED DYNAMICAL SYSTEMS: ODDS OF MEETING A GHOST

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Abstract. We consider dynamical systems whose parameters are stochastically switched within a discrete set of values at regular time intervals. Similarly to the blinking of the eye, switching is fast and occurs stochastically and independently for different time intervals. There are two time scales present in such systems, namely the time scale of the dynamical system and the time scale of the stochastic process. If the stochastic process is much faster, we expect the blinking system to follow the averaged system where the dynamical law is given by the expectation of the stochastic variables. We prove that with high probability, the trajectories of the two systems stick together for a certain lapse of time. We discover the presence of a soft upper bound for the time interval beyond which it is almost impossible to keep the two trajectories together. This comes as a surprise in view of the known perturbation analysis results. We also study convergence properties of blinking dynamical systems in the hardest case where multiple attractors of the averaged system are not invariant under the dynamics of the blinking system and act as ghost attractors.