

This paper addresses integral input-to-state stability (iISS) for stochastic nonlinear dynamical systems and develops Lyapunov-type criteria. The developments offer an iISS small-gain framework for verifying robustness of interconnected systems with respect to disturbances. The framework not only includes input-to-state stability (ISS) as a special case, but also highlights fundamental differences between the stochastic and deterministic systems. In particular, dealing with nonlinearities in interconnection gives rise to a unique issue of degradation in the presence of stochastic noises. This paper addresses this issue by coping judiciously with the effect of the gradient of Lyapunov functions of subsystems through diffusion fields in composing a Lyapunov function of the entire system. This paper employs two types of robustness notions, and demonstrates that the influence of the stochastic degradation on one notion is considerably different from the influence on the other notion in dealing with interconnected systems.