APPLIED DYNAMICAL SYSTEMS SEMINAR

Self-induced stochastic resonance: How new non-random behaviors can arise from the action of noise

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It is usually assumed that when a dynamical system is subjected to small random perturbations, its behavior remains essentially unchanged, apart from noise appearing on top of the otherwise deterministic dynamics. That this is not always the case is dramatically demonstrated by the phenomenon of stochastic resonance, whereby a small but finite amount of noise produces coherent phase locking between an applied periodic signal and the system's dynamical response. Perhaps even more surprisingly, the addition of small noise may produce new coherent behaviors that are fundamentally absent in the dynamics of the noise-free system. In other words, noise can actually play a constructive role in creating dynamics that are essentially non-random. This talk will present an overview of one robust mechanism by which such dynamics emerge out of noise which we termed self-induced stochastic resonance (SISR). I will demonstrate SISR in action for a range of systems whose common dynamical feature is excitability. I will show that both extrinsic and intrinsic noise in an excitable system may result in the onset of quasi-deterministic limit cycle oscillations, while in an excitable media the same mechanism produces traveling wave pacemakers. I will argue that one needs to re-examine the role of small noise in modeling the dynamics of complex dynamical systems.