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SENSITIVITY ANALYSIS OF STOCHASTIC EQUILIBRIA AND CYCLES FOR THE DISCRETE DYNAMIC SYSTEMS

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Abstract. The response problem of equilibria and cycles for stochastically forced discrete maps is considered. The probabilistic description of the corresponding stochastic attractors based on stochastic sensitivity function is suggested. Both for equilibria and cycles the stochastic sensitivity matrices are introduced and the numerical algorithms are suggested. An application of this technique to the sensitivity analysis of stochastically forced Hennon map attractors in the period-doubling bifurcation zone is demonstrated.

Keywords. Stochastic attractors, cycles, Hennon map, sensitivity analysis.

AMS (MOS) subject classification: Primary: 37H10, 37H20; Secondary: 37G15

1 Introduction

The modern theory of nonlinear phenomena dealing with the transition from order to chaos is based on the analysis of the bifurcations chain from the equilibrium through cycles to more complicated attractors. Regular attractors (equilibria and limit cycles) of the deterministic discrete dynamic systems are well studied [1, 7]. Stochastic fluctuations of the nonlinear oscillations play an important role for the understanding of the corresponding dynamical phenomena for electronic generators, lasers, mechanical, chemical and biological systems. The various noise-induced transitions attract the attention of many researchers [11, 13]. The random trajectories of the forced system leave the deterministic attractor and form some stationary probabilistic distribution around it. This distribution defines a corresponding stochastic attractor. A problem of the scaling for stochastic attractors of the random forced discrete systems in the period-doubling zone was studied by [9, 10, 5, 12]. The stationary probabilistic distribution of the stochastic attractor gives us a full and detailed description of its probabilistic features. Unfortunately, one can find an analytical representation of the stationary probabilistic distribution only for simplest particular cases. So, the asymptotics and approximations are actively used. For the continuous time systems with small noises, an asymptotic analysis based on the quasipotential function is widely used in