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STOCHASTIC PERTURBATIONS AND ULAM'S METHOD FOR POSITION DEPENDENT RANDOM MAPS SATISFYING THE STRONGER LASOTA-YORKE INEQUALITY

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Abstract. For a class of position dependent random maps satisfying the stronger Lasota - Yorke inequality we prove that the Ulam's method is a special case of small stochastic perturbations. Using the stronger Lasota-Yorke inequality [10], we establish the convergence for the Ulam's approximation method of probability density functions (pdfs) for position dependent random maps where components maps are maps on $[0, 1]$ into $[0, 1]$ satisfying the stronger Lasota-Yorke inequality. Our results are generalizations of results of Góra and Boyarsky [9] of single piecewise expanding maps to results of random maps. We present an example.

Keywords. Stochastic perturbations; Stronger Lasota-Yorke type inequality; Ulam's method; Position dependent random random maps; The Frobenius–Perron operator; Absolutely continuous invariant measures; Convergence of Ulam's method;

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1 Introduction

Physical systems are usually subjected to small perturbations from external noise or round-off errors. Random dynamical systems provide a useful framework for modeling and analyzing various physical [5], social, and economic [16] phenomena. A random map [11] is a discrete-time random dynamical system where one of a number of maps is selected randomly according to fixed probabilities [15] or position dependent probabilities [8] and applied in each iteration of the process. Random maps have applications in the study of fractals [2], in modeling interference effects in quantum mechanics [5], in computing metric entropy [18], and in forecasting the financial markets [17].

The existence and properties of absolutely continuous invariant measures for random dynamical systems reflect their long time behavior and play an