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Finite Difference Methods For Random Partial Differential Equations

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Abstract
Random partial differential equations (RPDEs) describe the partial differential equations involving random inputs which may be a random variable. In this paper, we focus on the numerical approximation of random parabolic and elliptic partial differential equations. The main properties of deterministic difference methods, i.e. consistency, stability and convergency, are separately developed for the stochastic case. It is shown that the proposed stochastic difference schemes for random parabolic and elliptic equations have these properties.

Keywords and phrases: Random partial differential equations, Finite difference scheme, Consistency, Stability, Convergence.

1. Introduction

Physical phenomena of interest in science and technology are very often theoretically simulated by means of models which correspond to partial differential equations (PDEs). These equations are in general nonlinear and, as such, their solution is usually a different task. Moreover, many times some of the parameters and initial data are not known with complete certainly due to lack of information or incomplete knowledge of the mechanism themselves, and in practice any system undergoes perturbations from the surrounding ambient and therefore the behavior of the system itself is, in several circumstances, far away from the simple condition of the ideal deterministic representation. To compensate this lack of information and to have a more realistic description of the system one introduces random noise in equation. This results in random partial differential equations (RPDEs). Some areas where PRDEs have been used extensively in modelling include chemistry, physics, engineering, mathematical biology and finance. This paper propose difference schemes to solve the PPDEs with a set of boundary and initial conditions. The structure of the paper is as follows. In the next section some definitions relevant to mean square calculus (see [1] for further details) are given. In continuation we use an explicit finite difference method for numerical solution a random parabolic partial differential, and investigate consistency,