

ON THE EXISTENCE OF A SOLUTION TO THE CAUCHY PROBLEM OF NONLINEAR STOCHASTIC PARTIAL FUNCTIONAL DIFFERENTIAL EQUATIONS OF SPECIAL FORM

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UDC 519.21

Abstract. A stochastic model is considered for processes described by systems of nonlinear stochastic partial functional differential equations of a special form, accounting for both Brownian-type diffusion perturbations and Poisson switching. The existence of a solution to the Cauchy problem for such systems is proved. The results obtained can be used to study the asymptotic stability of solutions of similar systems.

Keywords: stochastic partial functional differential equations, existence of a solution.

INTRODUCTION

Deterministic partial differential equations were solved by domestic and foreign scientists whose studies were published in the late 20th and early 21st centuries. In particular, these are A. D. Myshkis, M. V. Azbelev, Yu. O. Mytropolsky, A. M. Samoilenko, M. M. Perestyuk, V. P. Rubanyk, V. I. Fodchuk, D. I. Martynyuk, J. Hale, E. M. Wright, R. Bellman, K. L. Cooke, and many others (e.g., [1, 2]). The introduction of the concepts of stochastic differential and integral, variable substitution for stochastic differential, the definition of a strong solution of a stochastic differential equation (SDE) in well-known works [3–5] and their further extension to classes of stochastic functional differential equations (SFDEs) [6–9] made it possible to study asymptotically strong solutions for stochastic partial functional differential equations (SPFDEs). In particular, in the monograph [10, pp. 102–110], a theorem was proved on the solvability of the Cauchy problem for a linear parabolic stochastic equation with continuous perturbations, whose solution undergoes an impulse effect at fixed instants of time. Further research on SPFDE was carried out by developing mathematical models of complex real systems that require the consideration of random parameters in these equations [11–14]. In the paper, we will highlight the existence of a solution to the Cauchy problem for nonlinear stochastic partial functional differential equations of a special form.

PROBLEM STATEMENT

On a probabilistic basis $(\Omega, F, \{F_t, t \geq 0\}, P)$, the Itô-Skorokhod SPFDE of the form

$$\begin{aligned} du(t, x, \omega) = & \alpha_1(t, x, \omega) a(t, u_t, B_x u, B_{xx} u) dt \\ & + \alpha_2(t, x, \omega) b(t, u_t, B_x u_t, B_{xx} u_t) dw(t, \omega) \\ & + \int_Z \alpha_3(t, x, \omega) c(t, u_t, B_x u_t, B_{xx} u_t, z) \tilde{v}(dt, dz, \omega) \end{aligned} \quad (1)$$

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1060-0396/26/6202-0311