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Power Series Method for Stochastic Equations in Hilbert Space

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ABSTRACT

We consider power series method for stochastic equation

$$\xi(t) = \xi^s + \int_s^t A(\tau, \xi(\tau))d\tau + \int_s^t B(\tau, \xi(\tau))dw(\tau), \qquad 0 \le s \le t \le T, \quad (1)$$

where:

- $\xi(t) \in Y$
- $w(t)$ is Wiener process associated with a Hilbert-Schmidt triple:

$$w(t) \in H_- \supset H_0 \supset H_+;$$

- $A\colon [0,T] \times Y \to Y$, $B\colon [0,T] \times Y \to \mathcal{L}_2(H_0, Y)$;
- $A(t, y)$ and $B(t, y)$ are analytical function with respect to y in some small neighborhood of 0.

The power series method for deterministic differential equations is well-known, its correctness is caused by Cauchi-Kovalevskaya theorem. We prove an analogue of this theorem for the stochastic equations of type (1). To prove the result, we use the technique of stochastic equations in the space of formal (power) series. The result is proved for stochastic equations in Hilbert space with linear diffusion and analytical (in some small neighborhood of zero) drift, and for scalar equations with both analytical (possibly nonlinear) coefficients.

Keywords: *stochastic equation, formal series, power series, Cauchy-Kovalevskaya theorem*

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