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Method of averaging in the investigation of the information characteristics of fiber channels with small second dispersion

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We develop the method to obtain approximations to the solutions of differential equations with slowly varying coefficients. We demonstrate this method applying it to the linear partial differential equation of the first order and to the time-dependent Schrodinger equation in one dimension. Using the approximation to the solution of the Schrodinger equation, it is possible to calculate the partition function in the form of a perturbative expansion. In this expansion, the inverse typical scale of potential energy variation plays the role of the small parameter. To demonstrate that our method is suitable for obtaining the arbitrary order of the perturbative expansion, we find for the first time the statistical mechanic partition function up to the eighth order. Our method turns out to be applicable to the problem of the signal propagation described by the nonlinear Schrodinger equation with the additive Gaussian noise. We consider a fiber channel with large signal-to-noise ratio and small second dispersion. We also take into account the receiver which does not distinguish high-frequency harmonics of the propagating signal. For such model we obtain the expression for the output signal up to the first order in the small dimensionless parameter of the dispersion.

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