Co-existence of bursting-cycles in impulse neuron model with delay

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The dynamics of differential equation with delay occuring in the simulation of the impulse neuron is considered. The method of large parameter is used for research. As a result it is shown that bursting-cycles coexist in the model with an appropriate choice of parameters. Asymptotic formulas are constructed. Corresponding numerical analysis allows us to demonstrate the results.

Complete-return spectrum for a generalized Rosen-Zener two-state term-crossing model

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The general semiclassical time-dependent two-state problem is considered for a specific field configuration referred to as the generalized Rosen-Zener model. This is a rich family of pulse amplitude- and phase-modulation functions describing both non-crossing and term-crossing models with one or two crossing points. The model includes the original constant-detuning non-crossing Rosen-Zener model as a particular case. We shown that the system of equations is reduced to a confluent Heun equation. When inspecting the conditions for returning the system to the initial state at the end of the interaction with the field, we reformulate the problem as an eigenvalue problem for the peak Rabi frequency and apply the Rayleigh-Schrödinger perturbation theory. Further, we develop a generalized approach which is applicable for the whole variation region of the involved input parameters of the system. We examine the general surface $U_{0n} = U_{0n}(\delta_0, \delta_1)$, $n = \mathrm{const}$, in the 3D space of input parameters, which defines the position of the n-th order return-resonance and show that for fixed δ_0 the curve in $\{U_{0n}, \delta_1\}$ plane, i.e., the $\delta_0 = \mathrm{const}$ section of the general surface, is accurately approximated by an ellipse which crosses the U_{0n}-axis at the points $\pm n$ and δ_1-axis at the points δ_{11} and δ_{12}. We find a highly accurate analytic description of the functions $\delta_{11}(\delta_0, n)$ and $\delta_{12}(\delta_0, n)$ as the zeros of a Kummer confluent hypergeometric function. From the point of view of the generality, the analytical description of mentioned curve for the whole variation range of all involved parameters is the main result of the present paper.