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Non-linear dynamics of quantum and laser systems with elements of a chaos: Advanced computational code

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Abstract content
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The work is devoted to chaos-geometric modelling, analysis, prediction of a chaotic dynamics of quantum-generator and laser systems. The computing code includes a set of a analysis methods such as correlation integral, fractal analysis, average mutual information, surrogate data, false nearest neighbours algorithms, the Lyapunov's exponents, Kolmogorov entropy scheme, spectral methods, new prediction (predicted trajectories, neural network etc) ones s [1]. We present the results of studying chaos generation in the low- and high-attractor time dynamics of semiconductor GaAs/GaAlAs laser system with delayed feedback. It has been numerically shown that firstly arising periodic states of the system transform into individual chaotic states and then global chaotic attractor with a chaos generation scenario through period-doubling bifurcation, which is significantly modified. There are computed original data on the Lyapunov's exponents (+, +), correlation (chaos – 2.2; hyperchaos – 7.4), embedding (correspondingly 4 and 8), Kaplan-York (correspondingly 1.8 and 7.1) dimensions, the Kolmogorov entropy (0.15-0.71). We present the results of the complete numerical investigation of a chaos generation in the low- and high-attractor time dynamics of the erbium one-ring fibre laser (EDFL, 20.9mV strength, lambda;= 1550.190nm) with the control parameters: the modulation frequency f and dc bias voltage of the electro-optical modulator. It has been numerically shown that there are realized the one-period (f = 75MHz, V = 10V; f = 60MHz, V = 4V), two-period (f = 68 MHz, V = 10V; f = 60MHz, V = 6V) and chaotic (f = 64MHz, V = 10 V and f=60MHz, V=10V) regimes in dependence on f, V values. All invariants have been computed too.
[1] A.V.Glushkov et al, in: Adv. in Neural Networks, Fuzzy Systems and Artificial Intelligence, Ser.: Recent Adv. in Computer Engineering, Ed. J.Balicki.(Gdansk, WSEAS Pub.). 21, 143 (2014); Sensor Electr. and Microsyst.Techn. 11(4), 43 (2014).

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