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Nonlinear dynamics of laser systems: Chaos, bifurcations and strange attractors

Vasily Buyadzhi, Anna Buyadzhi, Alexey Chernyshev

Abstract: We present the results of numerical investigation of generating a chaos (scenario, topological and dynamical invariants etc) in single-mode laser with absorbing medium and in the erbium one-ring fibre laser (EDFL, 20.9mV strength, 1550.190nm length) with the control parameters: the modulation frequency f and dc bias voltage of the electro-optical modulator. It is shown that in depending upon f, V values there are realized 1-period f = 75MHz, V = 10V and f = 60MHz, V = 4V), 2-period (f = 68 MHz, V = 10V or f = 60MHz, V = 6V), chaotic (f = 64MHz, V = 10 V and f = 60MHz, V = 10V) regimes. The calculational data on the Lyapunov's exponents (LE), correlation, embedding and Kaplan-York dimensions (D), Kolmogorov entropy (KE) are presented. The application of the non-linear analysis, chaos theory and information technology methods (in [1,2]) to studying non-linear dynamics of the studied laser system (with the control parameters: the modulation frequency f and dc bias voltage of the electro-optical modulator) shows that there is a deterministic chaos in the erbium fiber laser device, generated via intermittency by increasing the DC bias voltage and the period-doubling bifurcation scenario by reducing the frequency modulation. References: [1] A. Glushkov: Methods of a chaos theory, Odessa, Astroprint, 2012. [2] A.Glushkov et al.: Adv. in Neural Networks, Fuzzy Systems and Artificial Intelligence, Series: Recent Adv. in Computer Eng., Ed. J.Balicki (Gdansk, WSEAS), 21 (2014) 143.

[1)] Vasily Buyadzhi, Associate Professor: Department of Applied Mathematics, Odessa State Environmental University, L'vovskaya str., 15, of. 408, Odessa, 65016, Ukraine (UA), buyadzhivv@gmail.com.

[2)] Anna Buyadzhi, M.Sc. (Ph.D. student): Department of Applied Mathematics, Odessa State Environmental University, L'vovskaya str., 15, of. 408, Odessa, 65016, Ukraine (UA), buyadzhiaa@gmail.com.

[3)] Alexey Chernyshev, M.Sc. (Ph.D. student): Department of Applied Mathematics, Odessa State Environmental University, L'vovskaya str., 15, of. 408, Odessa, 65016, Ukraine (UA), buyadzhiaa@gmail.com.