Synchronization of chaos of quantum dots lasers under the influence of external cavity optical feedback

A. Sanduța, T.Oloinic, S.S. Rusu V.Z. Tronciu

[1]*Department of Physics, Technical University of Moldova, Chisinau, Republic of Moldova*

[2]*Ferdinand-Braun-Institut Leibniz-Institut für Höchstfrequenztechnik*
Gustav-Kirchhoff-Straße 4, 12489 Berlin, Germany

During recent years, the phenomena of self-organization and chaos have received considerable attention due to its fundamental and applied interests. The main aim of technological progress is the production of structures with stable properties and the possibility of their application in different areas. From the application point of view, chaos-based communications have become an option to improve privacy and security in date transmission, especially after the recent field demonstration of the metropolitan fiber networks of Athens [1]. In optical chaos-based communications, the chaotic waveform is generated by using semiconductor lasers with either all-optical or electro-optical feedback loops. In particular, synchronized chaotic waveforms have found applications in chaos based communication systems. Semiconductor lasers subject to the influence of optical feedback from a distant mirror have been investigated extensively for the past two decades and different dynamical behaviors have been characterized, including periodic and quasi-periodic pulsations, low frequency fluctuations and coherent collapse. Optical feedback can considerably influence the dynamical behavior of a semiconductor laser Integrated lasers with ultra-short feedback cavities have also revealed similar characteristics if the feedback is properly amplified. We report the numerical results on the investigation of the dynamical behavior of a semiconductor laser with quantum dots active medium and a feedback from double cavity. Due to the influence of the external feedback, under the appropriate conditions, the system displays chaotic behavior appropriate for chaos-based communications. The optimal conditions and parameters for chaos generation and synchronization are identified. It is found that the double cavity feedback requires lower feedback strengths for developing high complexity chaos when compared with a single cavity.

1. Argyris A, Syvridis D, Larger L et al. (2005) Chaos-based communications at high bit rates using commercial fibre-optic links. Nature 438:343-346

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