Chaos-based optical communication of semiconductor lasers with air gaps

T. Oloinic, S.S. Rusu, V.Z. Tronciu[1,2]

[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 the last years, the dynamics of the semiconductor lasers became the subject of different investigations due to the interest in the prediction of the evolution of laser setups. Distributed feedback (DFB) lasers with multi sections are the key element for various devices used in the system of optical communication. It is well known that, in semiconductor laser applications the presence of an optical feedback is inevitable. The external mirrors of the lasers setup or the connection to other optical components of the system can create this feedback. Even small amount of the optical feedback created by a plane mirror can cause the system destabilization and appearance of instabilities. Thus, optical feedback can highly influence the dynamic behavior of the semiconductor laser (for more details see [1]). Even simple reflections from the exterior mirrors, might cause different phenomena as coherent collapse, frequency fluctuations, self-pulsations, chaos etc. The presence of periodical or chaotic oscillations is a well-known fact in semiconductor laser with optical feedback. The chaotic behavior can be both useful in the chaos based communication systems and unwelcome, and should rather be avoided or fixed, in other applications.

We report the numerical results of the dynamical behavior of a novel integrated semiconductor laser subject to multiple optical feedback loops. The laser's setup consists of distributed feedback active section coupled to multi section cavities. It is found that due to the multiple feedback loops and under certain operating conditions, the laser displays chaotic behaviors appropriate for chaos-based communications. The optimal conditions and suitable parameters for chaos generation are identified. The synchronization of two unidirectional-coupled (master–slave) systems is studied. Finally, example of 5 GB/s message encoding and decoding are presented and discussed.

1 Krauskopf B, Lenstra D (Eds.) (2000) Fundamental Issues of Nonlinear Laser Dynamics, AIP Conference Proceedings, 2000, pp 548.

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