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J.Thi-Qar Sci. Vol.5 (3) Dec./2015

ISSN 1991- 8690 الترقيم الدولي ١٩٩١ - ٨٦٩٠

The Dynamics of Semiconductor Laser under Optical Feedback

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Abstract:

The dynamical behavior of semiconductor laser in the present of optical feedback is studied by varying number of control parameters that appeared in the adopted theoretical model viz, linewidth enhancement factor , pump level , delay time and feedback level . Various dynamics seen to occur such as steady state, periodic, aperiodic and chaotic in the output of the semiconductor laser.

Keywords: Semiconductor laser, Optical feedback, Periodics, Chaos

حركيات ليزر شبه الموصل تحت تأثير التغذية العكسية البصرية

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الخلاصة

درس التصرف الحركي لليزر شبه الموصل بوجود التغذية العكسية البصرية عن طريق تغيير عدد من عوامل السيطرة الواردة في الأنموذج النظري المقترح وهي معامل تعزيز عرض الخط و مستوى الضخ وزمن التأخير ومستوى التغذية العكسية . لوحظت حركيات مختلفة في خرج ليزر شبه الموصل مثل التصرف المستقر والدوري واللا دوري والفوضوي .

Introduction

In 1980, Lang and Kobayashi [1] presented a theoretical model that describe the dynamics of a single mode semiconductor lasers (SCLs) under the effect of coherent optical feedback (OFB). Various types of feedback techniques have been applied into SCLs, such weak OFB [2], dispersive OFB [3], filtered OFB [4], optoelectronic FB[5], phase-conjugated FB[6], distributed FB [7], active OFB [8], nonlinear OFB [9] and negative optoelectronic feedback [10]. These techniques were applied for various objectives such as controlling nonlinear dynamics, enhancing nonlinear dynamics, creating spectral as well as time phenomena, stabilization, noise amplitude reduction, enhancing chaos, etc, in types of semiconductor lasers.In this article we study the dynamics of semiconductor lasers subjected to optical feedback based on a dimensionless model by varying the line-width enhancement factor, α, pump above threshold, P , delay time, θ , and feedback rate, Γ .

Theoretical model

The laser equations derived by Erzgraber et al. [4,11] consisted of three equations describing the