1. 引言

混沌是自然界普遍存在的一种非线性变化现象，具有对初值条件极为敏感以及具有随机变化特点，其长期行为是难以预测的。然而，其背后隐藏着有序的本质特性也逐渐被人们所发现。人们总是期望找到一些方法来控制混沌，使其实现对混沌系统中某个不稳定周期轨道的稳定控制。

2. 物理模型

外腔延时反馈半导体激光器，由于激光器外腔延时反馈作用，激光会呈现出许多复杂不稳定动力学现象，如在很大反馈参数范围内，激光都会呈现出混沌状态。
存在，该系统就是人们所熟知的外腔延时反馈激光器群速折射率，是激光场慢变部分，光衰减器延时双反馈半导体激光器混沌控制系统，如图。

为了控制激光混沌，先设计出外腔垂直正交偏振光线宽增强因子，然后，两偏振光交 

偏振面方向，光衰减器平面上平面偏振光，分别表示光子群速率和光在激光器腔长即是光子损耗系数，可控制反馈光输出的波形变化，可以看到控制过程是，平面镜间所形成的周期吸引子，显示该激光器已处于混沌状态。激光模式增益为是增益参量，可作为控制其反馈量，这样以后，激光输出强

\[
\frac{dE_x}{dt} = \frac{1}{2} \left( 1 + i \beta_x E_y \right) G_x - \gamma_{ps} E_x\ |E_x|^2 \\
+ \frac{k}{\tau_{kx}} E_x \ t - \tau_{v} \frac{\partial}{\partial x} - i \omega x, \tau \ |a|\ 10a
\]

\[
\frac{dE_y}{dt} = \frac{1}{2} \left( 1 + i \beta_y G_y - \gamma_{ps} E_y\ |E_y|^2 \\
+ \frac{k}{\tau_{ky}} E_y \ t - \tau_{v} \frac{\partial}{\partial x} - i \omega y, \tau \ |a|\ 10a
\]

\[
\frac{dN}{dt} = \frac{I}{q} - \gamma_c N - G_x V_p \ |E_x|\ t |^2 \\
- G_y V_p \ |E_y|\ t |^2| \ 10c
\]
度已呈现出周期变化,并和...及...呈现同步...进一步发现,...当...分别取...时,...都可控制到周期态,...当...1...时,...显示输出激光...强度被稳定控制的情况...而在...中发现,...后,...趋...于稳定,...主要原因是...具有反相位周期变化,...通常情况下这是非常少见的...偏振光...是周期变化的,...偏振光...是反周期...变化的,...激光强度则是稳定的...实现了一个激光器可...有三种行为激光控制输出...表...激光器参量...参量 值...参量 值...腔长...%...5...6...辐射复合因子...%...576...#...-...8...*...#$%...9...*/...腔宽...%...5...6...俄歇复合因子...%...576...+...-...8...*$...#$%...9...*/...腔厚...%...5...6.../...饱和光子场振幅...%...56...8...#5...*...*$++*...4...9...*/...压缩和限制因子...%.../...$...4...增益常数...%...576...*...$...%...9...*/...群速折射率...%...+...光线宽增强因子...%...7...光子损耗系数...%...576...8...*...04...驱动电流...%...延时时间...%...反馈系数...%...激光透明时载流子密度...%...非辐射复合速率...%...-...,...需要重新建立控制方程组,...其中在...式右边增加...偏振光反馈一项...而原来的...式右边的第二项...偏振反馈光一项...舍去...这样也可控制激光...到周期态,控制结果...如图所示,...其中控制参数...1...所示...这里...应用偏振控制器...使...偏振光振动面旋转到...偏振光振动...上,即可实现同偏振面方向控制...进一步利用偏振控制器...控制...使...偏振光振动面旋转到和...偏振光振动面成...角度方向...上,即可实现任意偏振面方向控制...重新建立...的控制方程组是在原来的...式右边增加...偏...反振面方向...投影一项...
5. Laser chaos is controlled into a periodic state. While the original equation on the right side of the second term is written as:

\[ \frac{k}{\tau_e} \sin(\theta) E(t - \tau_e) \exp(-i \omega \tau_e) \]

The control results are shown in Figure 1 and Figure 2. Among them, Figure 1 has control parameters as follows:

\[ \tau_e = 2.2 \text{ ns}, k_e = 0.018, \theta = \pi/10 \]

Laser can be controlled to seven periodic states. When \( \tau_e = 2.1 \text{ ns}, k_e = 0.011, \theta = \pi/12 \), the laser can be controlled to beat output states. Figure 2 is a multifrequency attractor, and Figure 3 is pseudoperiodic beat changes. The beat frequency is approximately 2107.50 Hz.
Control of chaos in an external cavity delay feedback semiconductor laser via modulating the polarizing light *

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Abstract

Control of chaos in an external cavity delay feedback semiconductor laser via modulating the feedback polarizing light is studied. The laser dynamic physical models of the delayed feedback of dual beams with orthogonal polarizing with parallel polarizations or with synchronous or arbitrary polarizing directions are presented respectively. The delay time and feedback quantity of the feedback light can be adjusted by adjusting the mirror and the optical attenuator in the external optical path or by adjusting the polarization plane of one beam of polarized light with respect to the polarization direction of the other beam or at an arbitrary polarization direction to the other beam of polarizing light. In all these cases the chaotic laser can be controlled. Numerical results show that the laser can be conducted to the single cycle or the multi-cycle and at the same time be in the polarizing oscillation polarizing anti-oscillation or stable states.

Keywords chaos control laser polarization

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