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Exponential synchronization for delayed nonlinear Schrödinger equation and applications in optical secure communication. (English) Zbl 1449.93101

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Summary: For further exploring the confidentiality of optical communication, exponential synchronization for the delayed nonlinear Schrödinger equation is studied. It is possible for time-delay systems to generate multiple positive Lyapunov exponents without the limitation of system dimension. Firstly, the homoclinic orbit analysis is carried out by using the bifurcation theory, and it is found that there are two homoclinic orbits in the system. According to the corresponding relationship, solitary waves also exist in the system. Secondly, the Melnikov method is used to prove that homoclinic orbits can evolve into chaos under arbitrary perturbations, and then chaotic signals are used as the carriers of information transmission. The Lyapunov exponent spectrum, phase diagram and time series of the system also prove the existence of chaos. Thirdly, an exponential synchronization controller is designed to achieve the chaotic synchronization between the driving system and the response system, and it is proved by the Lyapunov stability theory. Finally, the error system is simulated by using MATLAB, and it is found that the error tends to zero in a very short time. Numerical simulation results demonstrate that the proposed exponential synchronization scheme can effectively guarantee the chaotic synchronization within 1 s.

MSC:

93C10 Nonlinear systems in control theory
93C20 Control/observation systems governed by partial differential equations
94A60 Cryptography

Keywords:

secure communication; Melnikov method; nonlinear Schrödinger equation; exponential synchronization

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