-Chaos control of integer and fractional orders of chaotic Burke Shaw system using time delayed feedback control

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Abstract:

The aim of this paper is to investigate the control of chaotic Burke-Shaw system using Pyragas method. This system is derived from Lorenz system which has several applications in physics and engineering (e.g. secure communications). The linear stability and the existence of Hopf bifurcation of this system are investigated. Based on the characteristic equation, a theorem is stated and proved. This theorem is used to calculate the interval values of the time delay $ au $ at which this system is stable (unstable). By establishing appropriate time delay $ au $ and feedback strength K ranges, one of the unstable equilibria of this system can be controlled to be stable. We, also, introduced the fractional version of this system which is not studied in the literature as far as we know. The advantage of the fractional order system is that, the system has extra parameter which enriches its dynamics. Increasing the number of parameters may be used to increase the security of the transmitted information. We apply the Pyragas method to control the chaotic behavior of fractional Burke-Shaw system. As we did for the integer order, we determine the values of $ au $ and K which guarantee that the fractional version is stable. Finally, to support the analytical results, some numerical simulations are carried out which indicate that chaotic solution is turned to be stable if $ au $ passes through certain intervals. The bifurcation diagrams are calculated.

Keywords:

Time delay, Feedback control, Hopf bifurcation, Burke-Shaw, Fractional differential equation

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