

THESE du Dr FOTSIN (2005/2006)

Titre : Synchronisation des circuits électroniques non linéaires et application au masquage chaotique des communications

Abstrat :

This thesis first presents new, simple, economic and easily reproducible models of chaotic electronic circuits, namely a system consisting of a Van der Pol oscillator coupled to Duffing oscillator (VDP-D), a system consisting of a Van der Pol oscillator coupled to a linear oscillator (VDP-L), and a modified Van der Pol-Duffing oscillator (MVDPD). Some additional models of well-known chaotic oscillators to be used in thesis are also presented. The state equations describing the dynamics of the various systems are derived and their chaotic behaviour confirmed using the maximal en-dimensional Lyapunov exponent. A perturbation technique is then used to obtain analytical domains of phase synchronisation of two VDP-D systems. To this aims, the Floquet theory associated to Mathieu's equations and combined with the method of the Hill infinite determinant is used. It is found that the analytical results are then used to synchronize chaos in the various models. We first use the method of Grassi and Mascolo, based upon pole placement for the transition matrix of synchronisation errors dynamics, to design observers for synchronisation of VDP-L, MVDPD and Colpitts oscillators. Next, we use methods based on the second or direct Lyapunov's method to derive adaptive control laws and design nonlinear observers for chaos synchronisation of the various models. The generalised synchronisation of non-identical systems is also investigated, involving the modified Chua and the MVDPD systems. The practical implementation of the adaptive chaos synchronisation strategies is shown, and some Pspice simulations are performed to confirm the practical feasibility of our strategies. The practical applications of some of our observer design strategies in telecommunications are investigated and a laboratory experiment demonstrating the effectiveness of the proposed schemes is described.