

Analysis of control methods in Chua circuit

Modern Control Systems

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Abstract

Chua circuit is known for exhibiting chaotic behaviour. In this project we look upon different forms of control used in chua circuits and it's applications. Feedback, Non-feedback, Coupling and switching methods are used to control the chaos. The influence of control methods in the chaotic communication can be studied. Further research includes the feasibility of setting up chua transmission lines which can be used for communication as well as power lines.

Introduction

Chaotic behaviour is apparent in many natural phenomena. Modelling chaotic behaviour is tough and almost impossible. Chua circuit was the first circuit which showed chaotic behaviour. Many other circuits were considered as chaotic but weren't reliable due to absence of mathematical rigour. The applications of chua circuit are found in chaotic communications, synchronisation and VLSI.

Implementation of Chua Circuit

Chua circuit consists of linear elements like resistor, capacitor, inductor and a non linear element (Chua diode). Chua diode has similar characteristics as an amplifier. The chua circuit is implemented on Lt-Spice, Matlab.

$$\frac{dx}{dt} = \alpha(\mathbf{y} - \mathbf{x} - \mathbf{f}(\mathbf{x}))$$

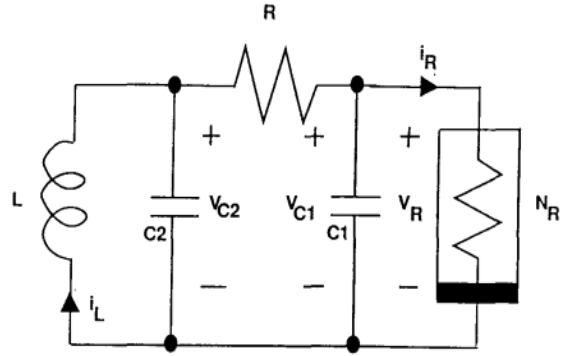
$$\frac{dy}{dt} = \mathbf{x} - \mathbf{y} + \mathbf{z}$$

$$\frac{dz}{dt} = -\beta(\mathbf{y} + \gamma \cdot \mathbf{Z})$$

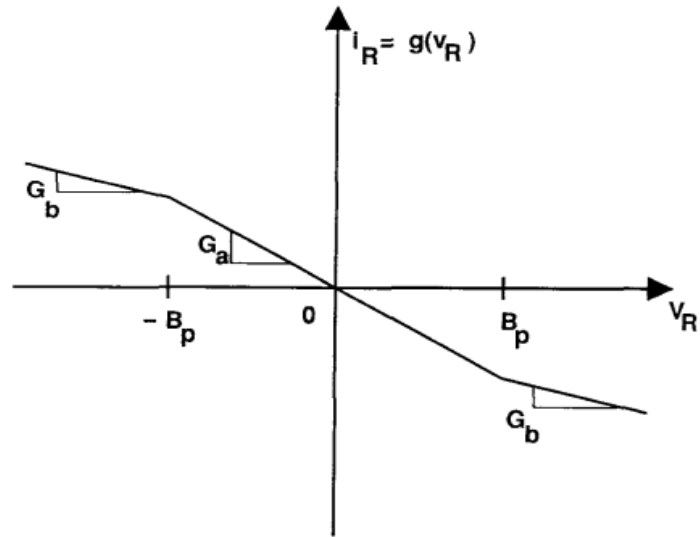
These equations are dimensionless equations which are derived from the circuit implementation of the chua circuit. The h function of the chua diode is also presented.

References

- [1] External and Internal Control Applications for SC-CNN-Based Chaotic Circuit by Enis Gunay et.al, 2011 20th European Conference on Circuit Theory and Design (ECCTD).
- [2] Chua's Circuit: Control and Synchronization, Stefan-Andrei Irimiciuc et.al, International Journal of Bifurcation and Chaos, Vol. 25, No. 4 (2015) 1550050
- [3] Controlling Chaos without Feedback and Control Signals, Kapitaniak et.al, International Journal of Bifurcation and Chaos, 1993



(a) A Chua-Circuit



(b) Chua-Diode I-V Characteristics

Figure 1: Chua Circuit and Diode

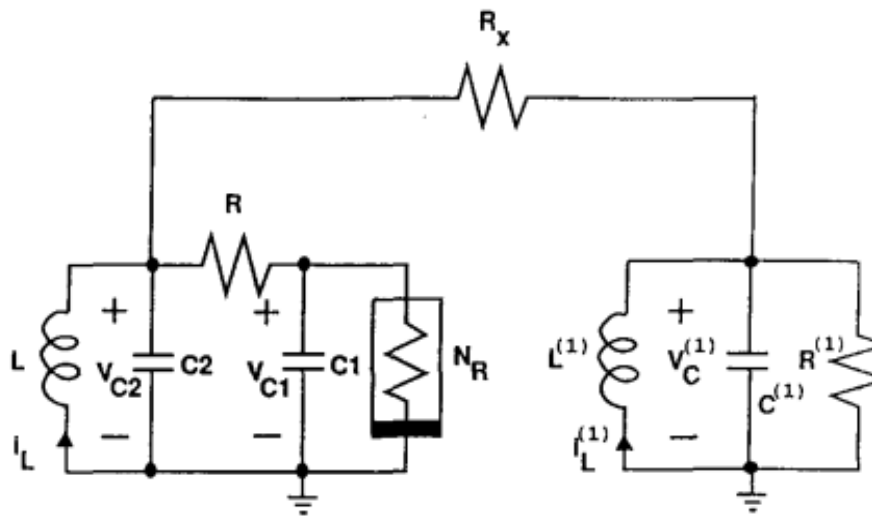


Figure 2: An example of Control Method