Stability analysis of multimode oscillations in three coupled memristor-based circuits

Yanjun Wang, Xiaofeng Liao

PII: S1434-8411(16)30354-5
DOI: http://dx.doi.org/10.1016/j.aeue.2016.07.005
Reference: AEUE 51655

To appear in: *International Journal of Electronics and Communications*

Received Date: 22 January 2016
Accepted Date: 7 July 2016

Please cite this article as: Y. Wang, X. Liao, Stability analysis of multimode oscillations in three coupled memristor-based circuits, *International Journal of Electronics and Communications* (2016), doi: http://dx.doi.org/10.1016/j.aeue.2016.07.005

Stability analysis of multimode oscillations in three coupled memristor-based circuits

Yanjun Wang [a], Xiaofeng Liao [a] [1]

[a] *Chongqing Key Laboratory of Nonlinear Circuits and Intelligent Information Processing, School of Electronic and Information Engineering, Southwest University, Chongqing, 400715, PR China*

Abstract

In this paper, first we construct a simple flux-controlled memristor-based circuit. By means of the ladder-type circuits coupled with inductors, furthermore, the three mutually coupled memristor oscillator circuits are designed. We mainly discuss dynamical behavior of three coupled memristor-based circuits, i.e., investigate the stability of the zero, single, double and multimode oscillations. Based on Krylov-Bogoliubov linearization method, the stability of the multimode oscillation for such circuits is determined in detail. Finally, computer simulations are conducted to verify the correctness of theoretical results.

Keywords: Flux-controlled memristor; oscillator circuits; multimode oscillations, stability

1. Introduction

The memristor is one of the four fundamental electronic elements in the circuit. At the beginning of 1970s [4], Leon Chua attempted to establish the six different mathematical relationships, which connecting pairs of the four fundamental circuit variables, i.e., the current i, the voltage v, the charge q and the flux φ. However, he observed that five of these relationships were well-known. Two of them are given by the definition of electric current and Faraday's law, i.e., $i = \frac{dq}{dt}, v = \frac{d\varphi}{dt}$. And, the others are given by the basic equations, which have axiomatically defined the three classical circuit elements, namely, $R = \frac{dv}{di}, L = \frac{d\varphi}{di}, C = \frac{dq}{dv}$, the R, L and C represent the resistance, the inductance, and the capacitance, respectively. Furthermore, Chua found that one relationship was undefined, i.e., the relationship between the flux φ and the charge q. Based on his observation, in 1971, he postulated in the seminal paper [15] that the fourth basic two-

[1] Corresponding author.
E-mail addresses: xfliao@swu.edu.cn.