Systematic topological characterization of the various chaotic attractors produced by a Chua circuit

Martin Rosalie & Christophe Letellier
CORIA - Université de Rouen, Saint-Etienne du Rouvray, France
martin.rosalie@coria.fr

Abstract

The Chua circuit is known not only for producing the double-scroll attractors but also a large variety of chaotic attractors. Nevertheless, since these various attractors were never topologically characterized, it is not so clear whether the Chua circuit can actually produce so many topologically inequivalent attractors. We thus propose to provide a topological analysis of the most different attractors, namely spiral and funnel attractors as produced by the Rssler system, attractors as those produced by Lorenz-like systems, and the double-scroll attractor. All these attractors are characterized by a genus-g bounding torus and a template made of g-1 branching lines. According to some conventions we introduced to limit the number of possible template for a given attractor, we show that these attractors can be described by g-1 mixers, one per component required to correctly compute the Poincar section. Each mixer is described by a linking matrix. Algebraic manipulations of these linking matrices according an additive law and a multiplicative law allow to easily checking whether all these attractors are different or not. Our conclusion is that if the Chua circuit is certainly one of the dynamical systems producing the largest variety of dynamics, the number of topologically inequivalent attractors it produces is not as large as sometimes claimed.

Keywords: Chua circuit, chaotic attractor, topological characterization, template