

Contents

1 Introduction	1
1.1 Self-Excited Attractors	1
1.2 Hidden Oscillations	4
1.3 Localization of Hidden Attractors	7
1.4 Control and Synchronization	7
1.5 Hidden Oscillations in Applied Models	9
1.5.1 Phase-Locked Loop Circuits	9
1.5.2 Automatic Control Systems	10
1.5.3 Chua’s Circuit Oscillator	10
1.5.4 Electromechanical Systems	10
1.6 Families of Systems with Hidden Attractors	11
1.6.1 Systems Without Equilibrium	11
1.6.2 Systems with Stable Equilibrium	12
1.6.3 Systems with an Infinite Number of Equilibria	12
References	13
2 Systems with Stable Equilibria	21
2.1 Wang–Chen System with Only One Stable Equilibrium	21
2.2 Simple Flows with One Stable Equilibrium	23
2.3 Systems with Stable Equilibrium Points	26
2.4 Constructing a System with One Stable Equilibrium	29
2.5 Double-Scroll Attractors in Systems with Stable Equilibria	31
2.6 Fractional-Order Form of a System with Stable Equilibrium	32
References	34
3 Systems with an Infinite Number of Equilibrium Points	37
3.1 Simple Systems with Line Equilibrium	37
3.2 Systems with Closed Curve Equilibrium	40
3.3 Systems with Open Curve Equilibrium	44
3.4 Constructing a System with Infinite Equilibria	46

3.5	Multi-scroll Attractors in a System with Infinite Equilibria	47
3.6	Fractional-Order Form of Systems with Infinite Equilibria.	48
	References	49
4	Systems Without Equilibrium	51
4.1	Sprott A (Nose–Hoover) System	51
4.2	Wei System Without Equilibrium.	52
4.3	Simple Systems with No Equilibrium.	53
4.4	Constructing a System with No Equilibrium	56
4.5	Multi-scroll and Multi-wing Attractors in Systems Without Equilibrium.	59
4.6	Fractional-Order Form of Systems Without Equilibrium	61
	References	62
5	Synchronization of Systems with Hidden Attractors	65
5.1	Synchronization via Diffusion Coupling.	65
5.1.1	Diffusion Coupling of Two Systems with One Stable Equilibrium	65
5.1.2	Diffusion Coupling of Two Systems with Infinite Equilibria	66
5.1.3	Diffusion Coupling of Two Systems Without Equilibrium.	67
5.2	Synchronization via Nonlinear Control.	68
5.2.1	Synchronization of Systems with One Stable Equilibrium.	69
5.2.2	Synchronization of Systems with Infinite Equilibrium	71
5.2.3	Synchronization of Systems Without Equilibrium.	74
	References	76
6	Circuitry Realization	79
6.1	Basic Electronic Components and Electronic Circuits	79
6.2	Circuit Implementation of a System with One Stable Equilibrium	83
6.3	Circuit Implementations of Systems with Infinite Equilibria.	86
6.3.1	Circuit Implementation of a System with Line Equilibrium.	86
6.3.2	Circuit Implementation of a System with Closed Curve Equilibrium	89
6.3.3	Circuit Implementation of a System with Open Curve Equilibrium	92
6.4	Circuit Implementation of a System Without Equilibrium	95
6.5	Circuit Implementation of a System with Different Families of Hidden Attractors.	98
	References	101

7 Concluding Remarks	103
References	104
Index	105



<http://www.springer.com/978-3-319-53720-7>

Systems with Hidden Attractors

From Theory to Realization in Circuits

Pham, V.-T.; Volos, C.; Kapitaniak, T.

2017, IX, 105 p. 61 illus., 23 illus. in color., Softcover

ISBN: 978-3-319-53720-7