

非线性和复杂系统的  
理论、方法和应用

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刘曾荣文选

# 非线性和复杂系统的 理论、方法和应用

——刘曾荣文选

刘曾荣 著



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刘曾荣教授

# 序 言

我是2013年10月正式退休。从1966年7月大学本科毕业算起,一共工作了47年3个月。

在工作的前期,从1966年7月到1967年12月,留在母校华东师范大学参加“文化大革命”。然后,从1967年12月到1978年10月,分配到了山西省大同市大同一中当一名中学教员。现在看来这12年是我一生中损失最大的12年,除了尽可能给所教的中学生讲授对学习有用的道理外,其他几乎没有做值得记忆的事。

自1978年考上研究生后,就一直在高校从事科研和教育工作。这35年的工作构成了我一生工作的主旋律。35年中,我先后在安徽大学、苏州大学和上海大学工作,工作的重点一直是科研工作。本书主要想为这35年的科研工作做一总结。

从我的工作经历来看,一辈子的科研工作所涉及的内容是丰富多彩的。我的工作主要是依托于我的数理基础来从事交叉研究。我曾经从事过与力学、物理、信息和生物的交叉研究。在所交叉领域都取得过一些成绩,在相关领域国际上认可杂志上发表过论文。35年实际科研工作的磨练,既积累了一些可供参考的经验,又有一些可供借鉴的教训。我想利用此机会,做一个总结,希望能对读者有所帮助。

本书共分三个部分。第一部分是科研工作一般性的总结,包括我从20世纪80年代以来直到2014年5月前发表的论文目录、我主持或参与的国家级的科研项目以及相关的资料。从中可以看到我是如何从一个科研的门外汉逐步成长为一个较成熟的科研工作者。第二部分是我选取的52篇代表性论文。论文的选取既要考虑我工作过的领域又要考虑到论文的意义,同时不但要考虑论文的发表时间而且要注意到尽可能多的博士生的贡献。从这部分中可以发现从事交叉研究特色,希望这个特色能对读者的研究工作有所启发。第三部分是我35年科研工作所走过的道路、科研工作的体会以及对年轻一代的期望。我殷切地希望年轻一代能实现把我国从科研大国向科研强国的转型。

最后,我要感谢我的导师许政范教授对我的培养,也要感谢在各个阶段曾经给予我帮助和鼓励的前辈和同行,他们是郝柏林院士、朱照宣教授、钱敏教授、姜礼尚教授和周哲玮教授。

刘曾荣

2015年10月

# 目 录

## 第一部分 科研工作一般性介绍

1.1 学术论文 .....	3
1.2 学术论著 .....	22
1.3 承担的主要科研项目 .....	24
1.4 国家自然科学基金委员会对研究工作的评价及获奖情况 .....	25
1.5 说明 .....	27

## 第二部分 代表性论文

Perturbation Solution of the Weak-Nonlinear Differential Equation with $\delta$ -Function .....	31
Chaotic Behavior in Planar Quadratic Hamiltonian System with Periodic Perturbation .....	39
Phase Plane Characteristics and Dynamic Stabilities for a Spiral Sector Cyclotron .....	47
Discontinuous and Impulsive Excitation .....	55
Structure of the Attracting Set of a Piecewise Linear Hénon Mapping .....	60
Higher-order Melnikov Method .....	70
A Centrosymmetric Chaos .....	83
The Strange Attractor of The Lozi Mapping .....	87
The Strange Attractor of a Kind of Two-dimensional Map and Dynamical Properties on It .....	100
The Measures of Sequence Complexity for EEG Studies .....	109
A New Method of Studying the Dynamical Behaviour of the sine-Gordon Equation .....	116
Information Transmission in Human Cerebral Cortex .....	122
Is There Chaotic Synchronization in Space Extend Systems? .....	133
The Schrödinger Operator .....	140
On Radii of Absorbing Sets for Kuramoto-Sivashinsky Equation .....	149
$p$ Dissipative Operator .....	160
Homoclinic Orbit in ODE on GAIM of the sine-Gordon Equation .....	190
Constructing new Periodic Exact Solutions of Evolution Equations .....	196

Controlling Hyperchaos .....	209
Straight-line Stabilization .....	215
On the Persistence of Lower-dimensional Invariant Hyperbolic Tori for Smooth Hamiltonian Systems .....	223
A New Synchronization Principle and Application to Chua's Circuits .....	238
Some Dynamical Behavior of Discrete Nagumo Equation .....	244
On Area-preserving Non-hyperbolic Chaotic Maps; A Case Study .....	254
Dynamics of Periodic Delayed Neural Networks .....	261
Singular Dynamics with Application to Singular Waves in Physical Problems .....	287
Efficient Target Strategies for Contagion in Scale-free Networks .....	297
A New Method to Realize Cluster Synchronization in Connected Chaotic Networks .....	304
From Lag Synchronization to Pattern Formation in One-dimensional Open Flow Models .....	319
Epidemic Spreading on Uncorrelated Heterogenous Networks with Non-uniform Transmission .....	328
From Lag Synchronization to Pattern Formation in Networked Dynamics .....	335
Synchronization of Complex Dynamical Networks via Impulsive Control .....	347
The Basin of Attraction of the Chen Attractor .....	362
Oscillatory Dynamics in a Simple Gene Regulatory Network Mediated by Small RNAs .....	371
Periodic Oscillation in Delayed Gene Networks with SUM Regulatory Logic and Small Perturbations .....	379
Mean-field Level Analysis of Epidemics in Directed Networks .....	403
Synchronisation Mechanisms of Circadian Rhythms in the Suprachiasmatic Nucleus .....	413
How Divergence Mechanisms Influence Disassortative Mixing Property in Biology .....	433
Emergence of Modularity and Disassortativity in Protein-protein Interaction Networks .....	444
An Efficient Range-free Localization Algorithm for Wireless Sensor Networks .....	457
Exponential Synchronization of Chaotic Systems with Time-varying Delays and Parameter Mismatches via Intermittent Control .....	470
The Interaction Between Multiplex Community Networks .....	487
Mechanisms Generating Bistability and Oscillations in MicroRNA-mediated Motifs .....	495
Different Water Scenarios for a Primitive Model with Two Types of Hydrogen Bonds .....	512
Dynamical Behaviors of Rb - E2F Pathway Including Negative Feedback Loops Involving miR449 .....	520
Chaotifying a Continuous-time System via Impulsive Input .....	539
Adaptability and Sensitivity of Complex Systems .....	550
MicroRNA-Mediated Regulation in Biological Systems with Oscillatory Behavior .....	559
Destructive Extraction of Phospholipids from Escherichia coli Membranes by Graphene	

nanosheets .....	570
Chaotic Stationary Solutions of Cellular Neural Networks .....	585
Overexpression of DCF1 Inhibits Glioma through Destruction of Mitochondria and Activation of Apoptosis Pathway .....	595
Dynamic Analysis of the Combinatorial Regulation Involving Transcription Factors and microRNAs in Cell Fate Decisions .....	608

### 第三部分 挑 战

挑战 .....	629
结束语 .....	655



第一部分  
科研工作一般性介绍



## 1.1 学术论文

### 1.1.1 期刊论文

#### 2014 年

1. Shuiming Cai, Peipei Zhou, Zengrong Liu. Synchronization analysis of directed complex networks with time-delayed dynamical nodes and impulsive effects. *Nonlinear Dyn*, 2014,76: 1677 – 1691.
2. Qinbin He, Zengrong Liu. Investigation of oscillation accumulation triggered genetic switch in gene regulatory networks. *Journal of Theoretical Biology*, 2014,353: 61 – 66.
3. Fang Yan, Haihong Liu, Zengrong Liu. Dynamic analysis of the combinatorial regulation involving transcription factors and microRNAs in cell fate decisions. *Biochimica et Biophysica Acta*, 2014,1844: 248 – 257.
4. Yuqiong Xie, Qiang Li, Qingbo Yang, Mei Yang, Zhifeng Zhang, Liucun Zhu, Huang Yan, Riuli Feng, Shiqing Zhang, Chen Huang, Zengrong Liu, Tieqiao Wen. Overexpression of DCF1 inhibits glioma through destruction of mitochondria and activation of apoptosis pathway, *Scientific Reports*, 2014,4: 3702.
5. Qingduan Fan, Guang Wu and Zengrong Liu. Dynamics of Posttranslational Modifications of p53. *Computational and Mathematical Methods in Medicine*, 2014.
6. Mei Lv, Bing He, Zengrong Liu, Peng Xiu, Yusong Tu. Charge-signal multiplication mediated by urea wires inside Y-shaped carbon, *J Chem. Phys.*, 2014,141: 044707.
7. P. Wang, J. Lü, X. Yu, Z. Liu, Duplication and divergence effect on network motifs in undirected bio-molecular networks. *IEEE Trans. Biomed. Circuits Syst.*, 2014.
8. Shuiming Cai, Peipei Zhou, Zengrong Liu. Pinning sychronization of hybrid-coupled directed delayed dynamical network via intermittent control. *Chaos*, 2014,24: 033102.

#### 2013 年

9. Fang-Yue Chen, Zeng-Rong Liu. Chaotic stationary solutions of cellular neural networks. *International Journal of Bifurcation and Chaos*, 2003,13(11): 3499 – 3504.
10. Tu Yusong, Lv Min, Xiu Peng, Tien Huynh, Zhang Meng, Castelli Matteo, Liu Zengrong, Huang Qing, Fan Chunhai, Fang Haiping, Ruhong Zhou, Destructive extraction of phospholipids from Escherichia Coli membranes by grapheme nanosheets. *Nature Nanotechnology*, 2013,8(8): 594 – 601.
11. Yan Fang, Liu Haihong, Liu Zengrong. Dynamic analysis of the combinatorial regulation involving transcription factors and microRNAs in cell fate decisions. *Biochimica et Biophysica Acta*, 2013.
12. Zhiyong Zhang, Fengdan Xu, Zengrong Liu, Ruiqi Wang, Tieqiao Wen. MicroRNA-mediated regulation in biological systems with oscillatory behavior. *BioMed Research International*, 2013.
13. Cai Shuiming, Zhou Peipei, Liu Zengrong. Functional characteristics of a double negative

- feedback loop mediated by microRNAs. *Cogn Neurodyn*, 2013, 7(5): 417 – 429.
14. Li Ying, Liu Zengrong, Luo Jinhua, Wu Hui. Coupling-induced synchronization in multicellular circadian oscillators of mammals. *Cogn Neurodyn*, 2013, 7(1): 59 – 65.
  15. Cai Shuiming, He Qinbin, Liu Zengrong. Analyzing the topological structure of networks and related problem via simple rules//Casandra Rendell. *Network Topologies: Types, Performance Impact and Advantages/Disadvantages*. Nova Publister Inc, New York, 2013: 1 – 44.
  16. Zhicheng Ye, Qingduan Fan, Qinbin He, Zengrong Liu. Adaptability and sensitivity of complex systems. *IJBC*, 2013, 23(9): 1350163.
  17. Liu Haihong, Yan Fang, Liu Zengrong. Oscillatory dynamics in a gene regulatory network mediated by small RNA with time delay. *Nonlinear Dyn*, 2013.
  18. 叶志成, 贺勤斌, 刘曾荣: 《生化网络中基序的适应性和敏感性》, 《生物物理学报》, 2013 年第 2 期。

#### 2012 年

19. Tu YS, Buldyrev SV, Liu ZR, Fang HP, Stanley HE. Different water scenarios for a primitive model with two types of hydrogen bonds. *Epl-Europhys Lett*, 2012, 97(5).
20. Zhang H, Zhou J, Liu ZR: Synchronization of networked harmonic oscillators with communication delays under local instantaneous interaction. *J Dyn Syst-T Asme*, 2012, 134(6): ?? – ??.
21. Zhou PP, Cai SM, Liu ZT, Wang RQ. Mechanisms generating bistability and oscillations in microRNA-mediated motifs. *Physical Review E*, 2012, 85(4).
22. Ling Yang, Zhengrong Liu, Guanrong Chen. Chaotifying a continuous-time system via impulsive input. *International Journal of Bifurcation and Chaos*. 2012, 12(5): 1121 – 1128.
23. Fang Yan, Haihong Liu, Junjun Hao, Zengrong Liu. Dynamical behaviors of Rb – E2F pathway including negative feedback loops involving miR449. *Plos One*, 2012, 7(9): e43908.
24. Tu YS, Buldyrev SV, Liu ZR, Fang HP, Stanley HE. Different water scenarios for a primitive model with two types of hydrogen bonds. *EPL*, 2012, 97(5): 56005.
25. Zhang H, Zhou J, Liu ZR. Synchronization of networked harmonic oscillators with communication delay under local instantaneous interaction. *Journal of Dynamic Systems, Measurement, and Control by ASME (Transactions of ASME)*, 2012, DOI: 10.1115/1.4006365.
26. Zhou PP, Cai SM, Liu ZR, Wang RQ. Mechanisms generating bistability and oscillations in microRNA-mediated motifs. *Phys. Rev. E*, 2012, 85: 041916.
27. Yan F, Liu HH, Liu ZR. The bifurcation and exact travelling wave solutions for the modified Benjamin-Bona-Mahoney (mBBM) equation. *Commun. Nonlinear Sci. Numer. Simul*, 2012, 17: 2824 – 2832.
28. Yan F, Hua CC, Liu HH, Liu ZR. The exact travelling wave solutions and their bifurcations in the Gardner and Gardner-KP equations. *Int. J. Bifurcation Chaos*, 2012, 22(5): 1250126.
29. 万茜, 周进, 刘曾荣: 《蛋白质相互作用网络特征的理论再现》, 《物理学报》, 2012 年第 1 期。

## 2011 年

30. Cai SM, Hao JJ, He QB, Liu ZR. New results on synchronization of chaotic systems with time-varying delays via intermittent control. *Nonlinear Dynamics*, 2011, 67(1): 393–402.
31. Chang X, Liu DY, Liu ZR, Chen LN, Wang RQ. Adaptation of simple molecular networks to time-dependent stimulus. *Asian Journal of Control*, 2011, 13(5): 701–712.
32. Hao JJ, Cai SM, He QB, Liu ZR. The interaction between multiplex community networks. *Chaos*, 2011, 21(1): 016104.
33. Liu DY, Chang XA, Liu ZR, Chen LN, Wang RQ. Bistability and oscillations in gene regulation mediated by small noncoding RNAs. *Plos One*, 2011, 6(3): e17029.
34. Cai SM, Hao JJ, Liu ZR. Exponential synchronization of chaotic systems with time-varying delays and parameter mismatches via intermittent control. *Chaos*, 2011, 21(2): 023112.
35. Cai SM, Hao JJ, He QB, Liu ZR. Exponential synchronization of complex delayed dynamical networks via pinning periodically intermittent control. *Physics Letters A*, 2011, 375(19): 1965–1971.
36. He QB, Chen FY, Cai SM, Hao JJ, Liu ZR. An efficient range-free localization algorithm for wireless sensor networks. *Science China (Technological Sciences)*, 2011, 54(5): 1053–1060.
37. 贺勤斌, 郝军军, 蔡水明, 王瑞琦, 刘曾荣: 《包含沉默转录因子和 miR-21 的胚胎干细胞调控网络的双稳开关及鲁棒性研究》, 《生物物理学报》, 2011 年第 12 期。

## 2010 年

38. Fu XC, Chen ZH, Gao HJ, Li CP, Liu ZR. Chaotic sets of continuous and discontinuous maps. *Nonlinear Anal-Theor*, 2010, 72(1): 399–408.
39. Liu DY, Chang XA, Liu ZR, Chen LN, Wang RQ. The effect of coupled feedback on noise filtering in signal transduction networks. *J. Syst. Sci. Complex*, 2010, 23(5): 942–950.
40. Cai SM, He QB, Hao JJ, Liu ZR. Exponential synchronization of complex networks with nonidentical time-delayed dynamical nodes. *Physics Letters A*, 2010, 374(25): 2539–2550.
41. Hao JJ, Cai SM, He QB, Liu ZR. A unifying modularity in networks. *Chinese Physics Letters*, 2010, 27(12): 213–216.
42. Wan X, Cai SM, Zhou J, Liu ZR. Emergence of modularity and disassortativity in protein-protein interaction networks. *Chaos*, 2010, 20(4): 045113.
43. Xu CS, Liu ZR, Wang RQ. How divergence mechanisms influence disassortative mixing property in biology. *Physica A*, 2010, 389(3): 643–650.
44. Zhang W, Zhang G, Liu ZR. Synchronization of coupled nonidentical dynamical systems. *Chinese Physics Letters*, 2010, 27(3): 030504.
45. 贺勤斌, 刘曾荣: 《非线性可分 Boolean 函数分解及神经网络实现》, 《科学技术与工程》, 2010 年第 11 期。
46. 许醇穗, 刘曾荣: 《生物网络中的随机变异机制与度负关联性的关系》, 《力学学报》, 2010 年第 5 期。

## 2009 年

47. Li Y, Liu ZR, Zhang J, Wang RQ, Chen L. Synchronisation mechanisms of circadian

- rhythms in the suprachiasmatic nucleus. *IET Syst. Biol.*, 2009, 3(2): 100 – 112.
48. Cai SM, Liu ZR, Xu FD, Shen JW. Periodically intermittent controlling complex dynamical networks with time-varying delays to a desired orbit. *Physics Letters A*, 2009, 373(42): 3846 – 3854.
49. Wang JZ, Liu ZR. Mean-field level analysis of epidemics in directed networks. *J. Phys. A-Math Theor*, 2009, 42(35): 355001.
50. Wang Y, Ma ZJ, Shen JW, Liu ZR, Chen LN. Periodic oscillation in delayed gene networks with SUM regulatory logic and small perturbations. *Mathematical Biosciences*, 2009, 220(1): 34 – 44.
51. Zhang JB, Liu ZR, Xu JH. Synchronization in oscillator networks with coupling balance. *Chaos, Solitons and Fractals*, 2009, 39(2): 556 – 566.
52. Shen JW, Liu ZR, Zheng WX, Xu FD, Chen LN. Oscillatory dynamics in a simple gene regulatory network mediated by small RNAs. *Physica A*, 2009, 388(14): 2995 – 3000.
53. Wang Y, Shen JW, Niu BG, Liu ZR, Chen LN. Robustness of interval gene networks with multiple time-varying delays and noise. *Neurocomputing*, 2009, 72(13 – 15): 3303 – 3310.
54. Xu F, Liu Z, Shen J, Wang R. Dynamics of microRNA-mediated motifs. *IET Syst. Biol.*, 2009, 3(6): 496 – 504.
55. Xu FD, Liu ZR, Zhang ZY, Shen JW. Robust and adaptive microRNA-mediated incoherent feedforward motifs. *Chinese Physics Letters*, 2009, 26(2): 028701.
56. Zhou J, Wu QJ, Xiang L, Liu ZR. Impulsive control and synchronization of chaotic Hindmarsh-Rose models for neuronal activity. *Chaos, Solitons and Fractals*, 2009, 41(5): 2706 – 2715.
57. 费敏锐, 狄轶娟, 刘曾荣, 朱新广: 《植物代谢系统的建模与仿真》, 《中国计算机学会通讯》, 2009 年第 9 期。
58. 刘曾荣, 张志勇: 《应用数学与复杂网络》, 《科学》, 2009 年第 3 期。
59. 周进, 吴泉军, 刘曾荣: 《复杂多个体时滞网络系统的脉冲一致性》, 《上海大学学报(自然科学版)》, 2009 年第 6 期。

### 2008 年

60. Huang J, Wang JZ, Liu ZR. Numerical studies on the epidemic spreading on correlated networks. *International Journal of Nonlinear Science*, 2008, 15(1): 20 – 24.
61. Li Y, Liu ZR, Zhang JB. Synchronization between different networks. *Chinese Physics Letters*, 2008, 25(3): 874 – 877.
62. Zhang JB, Liu ZR, Li Y. Synchronization in oscillator networks with nonlinear coupling. *Commun Theor. Phys.*, 2008, 50(4): 925 – 930.
63. Ma ZJ, Zhang G, Wang Y, Liu ZR. Cluster synchronization in star-like complex networks. *J. Phys. A-Math Theor.*, 2008, 41(15): 155101.
64. Shi XM, Zheng YF, Liu ZR, Yang WZ. A model of calcium signaling and degranulation dynamics induced by laser irradiation in mast cells. *Chinese Science Bulletin*, 2008, 53(15): 2315.
65. Xu FD, Luo JG, Liu ZR. From chaos to order via synchronization. *Communication on applied*

*mathematics and computation*, 2008,22(02): 35-40.

66. Zhang G, Liu ZR, Zhang JB. Adaptive synchronization of a class of continuous chaotic systems with uncertain parameters. *Physics Letters A*, 2008,372(4): 447-450.
67. Zhou J, Cai SM, Xiang L, Liu ZR. Robust impulsive synchronization of complex delayed dynamical networks. *Physics Letters A*, 2008,372(30): 4990-4995.
68. 施小民,郑毓蕃,刘曾荣,杨文忠:《激光照射引发的肥大细胞内钙信号和脱颗粒动力学模型》,《科学通报》,2008年第11期。
69. 周进,刘曾荣:《具有脉冲效应复杂时滞动力网络的同步动力学与控制》,《科技导报》,2008年第2期。
70. 赵丹,黄睿,刘曾荣:《一个基于复制变异准则的蛋白质作用网络的构建模型》,《应用数学与计算数学学报》,2008年第1期。
71. 徐凤丹,罗吉贵,刘曾荣:《通过同步实现从混沌到有序的转变》,《应用数学与计算数学学报》,2008年第2期。

### 2007年

72. Dong CD, Liu ZR. An ideal assortative network and synchronization. *Commun Theor. Phys.*, 2007,47(1): 186-192.
73. Liu ZR, Dong CD, Fan QD. Multicenter network and synchronization. *International Journal of Bifurcation and Chaos*, 2007,17(6): 2109-2115.
74. Liu ZR, Li Y, Chen GR. The basin of attraction of the Chen attractor. *Chaos, Solitons and Fractals*, 2007,34(5): 1696-1703.
75. Liu ZR, Ma ZJ, Zhang G. Generalized synchronization of discrete systems. *Appl. Math. and Mech.*, 2007,28(5): 609-614.
76. Liu ZR, Zhang G, Ma ZJ. Generalized synchronization of continuous dynamical system. *Appl. Math. and Mech.*, 2007,28(2): 157-162.
77. Zhang G, Liu ZR, Ma ZJ. Synchronization of complex dynamical networks via impulsive control. *Chaos*, 2007,17(4): 043126.
78. Zhang JB, Liu ZR, Li Y. An approach to analyse phase synchronization in oscillator networks with weak coupling. *Chinese Physics Letters*, 2007,24(6): 1494-1497.
79. Zhang ZY, Luo JG, Liu ZR. From lag synchronization to pattern formation in networked dynamics. *Physica A*, 2007,378(2): 537-549.
80. Zhao D, Liu ZR, Wang JZ. Duplication: a mechanism producing disassortative mixing networks in biology. *Chinese Physics Letters*, 2007,24(10): 2766-2768.
81. Wang JZ, Liu ZR, Xu JH. Epidemic spreading on uncorrelated heterogenous networks with nonuniform transmission. *Physica A*, 2007,382(2): 715-721.
82. Xu JH, Liu ZR, Wang JZ. Liapunov methods for error estimate of waveform relaxation. *International Journal of Nonlinear Science*, 2007,3(1): 40-43.
83. Li Ying, Liu ZR, Zhang JB. Dynamics of network motifs in genetic regulatory networks. *Chinese Phys.*, 2007,16(9): 2587-2594.
84. Zhang G, Liu ZR, Ma ZJ. Generalized synchronization of different dimensional chaotic dynamical systems. *Chaos, Solitons and Fractals*, 2007,32(2): 773-779.

85. Zhang HL, Liu ZR, Zhang W. Growth estimates and blow-up in quasilinear parabolic problems. *Applicable Analysis*, 2007,86(2): 261 – 268.
86. Zhou J, Xiang L, Liu ZR. Global synchronization in general complex delayed dynamical networks and its applications. *Physica A*, 2007,385(2): 729 – 742.
87. Zhou J, Xiang L, Liu ZR. Synchronization in complex delayed dynamical networks with impulsive effects. *Physica A*, 2007,384(2): 684 – 692.
88. 陈洛南,王勇,费敏锐,刘曾荣:《从理工科视角探索系统生物学》,《科技导报》,2007 年第 10 期。
89. 刘曾荣,周进:《非线性动力学理论的若干进展和展望》,《中国力学文摘》,2007 年第 4 期。
90. 赵德勤,刘曾荣:《基于追踪控制的混沌系统广义同步》,《重庆邮电大学学报(自然科学版)》,2007 年第 6 期。

### 2006 年

91. Dong CD, Liu ZR. An ideal disassortative network and synchronization. *International Journal of Bifurcation and Chaos*, 2006,16(10): 3093 – 3102.
92. Duan WQ, Chen Z, Liu ZR. Epidemic spreading in contact networks based on exposure level. *Chinese Physics Letters*, 2006,23(5): 1347 – 1350.
93. Li Y, Liu ZR. Riddled property of the attracted basin of chen attractor. *Communication On Applied Mathematics and Computation*, 2006,20(1): 51 – 55.
94. Li Y, Zhang JB, Liu ZR. Circadian oscillators and phase synchronization under a light-dark cycle. *International Journal of Nonlinear Science*, 2006,1(3): 131 – 138.
95. Lin YP, Ma ZJ, Liu ZR. Asymptotic bifurcation of an everted Varga spherical shell. *Chinese Journal of Computational Mechanics*, 2006,23(5): 536 – 539.
96. Liu ZR, Chen J, Chen GR. Riddle property of the basin of attraction of the Lorenz attractor. *Dynamics of Continuous, Discrete and Impulsive Systems Series B: Applications and Algorithms*, 2006,13: 27 – 34.
97. Liu ZR, Luo JG. Realization of complete synchronization between different systems by using structure adaptation. *Chinese Physics Letters*, 2006,23(5): 1118 – 1121.
98. Liu ZR, Luo JG. From lag synchronization to pattern formation in one-dimensional open flow models. *Chaos, Solitons and Fractals*, 2006,30(5): 1198 – 1205.
99. Ma ZJ, Liu ZR, Zhang G. A new method to realize cluster synchronization in connected chaotic networks. *Chaos*, 2006,16(2): 023103.
100. Wan YS, Chen Z, Liu ZR. Modeling the two-power-law degree distribution of banking networks. *Dynamics of Continuous, Discrete and Impulsive Systems Series B: Applications and Algorithms*, 2006,13(3 – 4): 441 – 449.
101. Yang B, Chen Z, Liu ZR, Duan NQ. Research on structural evolution and pattern emergence of socio-economic complex networks based on individual choices. *Dynamics of Continuous, Discrete and Impulsive Systems Series B: Applications and Algorithms*, 2006,13(3 – 4): 387 – 394.
102. Li T, Liu ZR. Upper semi-continuity of attractors for multivalued semi-flow under random



- perturbation. *Journal of Shanghai University*, 2006,10(4): 288 - 292.
103. 马忠军,刘曾荣,张刚:《混沌网络的聚类同步方法》,《力学学报》,2006年第3期。
104. 李挺,刘曾荣:《复杂系统中的自适应性》,《浙江师范大学学报(自然科学版)》,2006年第4期。
105. 李莹,刘曾荣:《陈吸引子一个“奇怪”性质的研究》,《应用数学与计算数学学报》,2006年第1期。
106. 林怡平,马忠军,刘曾荣:《翻转的 Varga 材料球壳的渐近分支》,《计算力学学报》,2006年第5期。

### 2005 年

107. Chen J, Liu ZR. Partial synchronization between different systems. *Appl. Math. and Mech.*, 2005,26(9): 1132 - 1137.
108. Duan WQ, Chen Z, Liu ZR. Phase transition dynamics of collective decision in scale-free networks *Chinese Physics Letters*, 2005,22(8): 2137 - 2139.
109. Duan WQ, Chen Z, Liu ZR, Jin W. Efficient target strategies for contagion in scale-free networks. *Physical Review E*, 2005,72(2): 026133.
110. Jin Z, Shu S, Liu ZR. Periodic solutions of forced Lienard-type equations. *Appl. Math. and Comput.*, 2005,161(2): 655 - 666.
111. Liu ZR, Chung KW. Hybrid control of bifurcation in continuous nonlinear dynamical systems. *International Journal of Bifurcation and Chaos*, 2005,15(12): 3895 - 3903.
112. Liu ZR, Zhang G, Ma ZJ. Several results to realize generalized synchronization in dynamical systems. *Dynamics of Continuous, Discrete and Impulsive Systems Series B: Applications and Algorithms*, 2005,2: 790 - 794.
113. Shi XM, Liu ZR. An intracellular calcium oscillations model including mitochondrial calcium cycling. *Chinese Physics Letters*, 2005,22(12): 3206 - 3209.
114. Zhang HL, Liu ZR, Zhang W. Blow-up of positive solution of quasilinear parabolic equations with nonlinear Neumann boundary conditions. *Global Journal of Pure and Applied Mathematics*, 2005,2: 225 - 233.
115. Zhou J, Liu ZR, Chen GR. Global dynamics of periodic delayed neural networks models. *Dynamics of Continuous, Discrete and Impulsive Systems Series B: Applications and Algorithms*, 2005,12(5-6): 689 - 699.
116. Zhou J, Liu ZR, Xiang L. Global dynamics of delayed bidirectional associative memory (BAM) neural networks. *Appl. Math. and Mech.*, 2005,26(3): 327 - 335.
117. 陈骏,陈忠,刘曾荣:《探讨复杂系统中的群体结构》,《复杂系统与复杂性科学》,2005年第2期。
118. 罗吉贵,刘曾荣:《从同步到涌现》,《复杂系统与复杂性科学》,2005年第1期。
119. 方锦清,汪小帆,郑志刚,李翔,狄增如,刘曾荣:《非线性复杂网络研究的若干进展》,《中国原子能科学研究院年报》,2005年。

### 2004 年

120. Chen GR, Zhou J, Liu ZR. Global synchronization of coupled delayed neural networks and