

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Research background and significance . . . . .	1
1.2	State-of-the-art of chaos-based cryptography . . . . .	2
1.3	About the dissertation . . . . .	4
<b>2</b>	<b>CML and Spatiotemporal Chaos</b>	<b>7</b>
2.1	Introduction . . . . .	7
2.2	A spatiotemporal chaotic system . . . . .	8
2.3	Li-Yorke chaos and Marotto theorem . . . . .	8
2.4	Li-Yorke chaos in a CML . . . . .	11
<b>3</b>	<b>Chaotification of CML</b>	<b>17</b>
3.1	Introduction . . . . .	17
3.2	Chaotification: background and algorithms . . . . .	18
3.3	Chaotification algorithm designed for a CML . . . . .	19
3.4	Devaney chaos in the controlled CML . . . . .	22
3.5	Simulations . . . . .	23
<b>4</b>	<b>Multiple-Output Pseudo-Random-Bit Generators</b>	<b>28</b>
4.1	Introduction . . . . .	28
4.2	State-of-the-art of chaos-based PRBGs . . . . .	29
4.2.1	Chaotic maps . . . . .	29
4.2.2	Digitization methods . . . . .	29
4.2.3	Configurations . . . . .	30
4.2.4	Analysis of PRBGs' properties . . . . .	31
4.2.5	Techniques for improving PRBGs' properties . . . . .	31
4.3	Design of a multiple-output PRBG based on a CML . . . . .	32
4.4	Properties of the PRBG . . . . .	33
4.4.1	Dynamical properties of the CML . . . . .	33
4.4.2	Random-like statistical properties . . . . .	36
4.5	PRBGs based on various CMLs . . . . .	37
4.5.1	Statistical properties of the PRBGs . . . . .	38
4.5.2	Comparison of PRBGs based on various CMLs . . . . .	42
<b>5</b>	<b>Stream Cipher Based on CML</b>	<b>45</b>
5.1	Introduction . . . . .	45
5.2	Design a CML-based stream cipher . . . . .	46
5.2.1	Algorithm of the cipher . . . . .	46
5.2.2	Keyspace . . . . .	47
5.3	Cryptographic properties of the keystream . . . . .	48

5.3.1	Probability distribution . . . . .	48
5.3.2	Run . . . . .	49
5.3.3	Auto-correlation . . . . .	49
5.3.4	Statistical tests . . . . .	50
5.4	Security Analysis . . . . .	51
5.4.1	Confusion and diffusion . . . . .	51
5.4.2	Error function attack . . . . .	52
5.4.3	Differential attack . . . . .	52
5.4.4	Known-plaintext attack . . . . .	53
5.4.5	Chosen-plaintext/ciphertext attack . . . . .	53
5.5	High Efficiency . . . . .	54
5.6	Discussion . . . . .	55
<b>6</b>	<b>CML-based Multimedia Cryptosystems</b>	<b>57</b>
6.1	Introduction . . . . .	57
6.2	CML-based multimedia cryptosystem . . . . .	59
6.2.1	EPP communication between PC and FPGA . . . . .	59
6.2.2	FPGA implementation of the CML-based cipher . . . . .	61
6.2.3	The cryptosystem with EPP communication . . . . .	64
6.2.4	User interface . . . . .	65
6.2.5	Profile of the cryptosystem . . . . .	65
6.3	Performance analysis . . . . .	69
6.3.1	Properties of the cryptosystem . . . . .	69
6.3.2	Effect of encrypting multimedia . . . . .	72
6.4	Secure CML-based video conferencing system . . . . .	78
6.4.1	A video encryption algorithm based on a CML . . . . .	78
6.4.2	The real-time video conferencing system . . . . .	80
6.4.3	Performance of the video conferencing system . . . . .	80
<b>7</b>	<b>Conclusion</b>	<b>82</b>
	<b>References</b>	<b>85</b>