

Contents

Acknowledgments	i
Abstract	vii
Zusammenfassung	ix
1 Introduction	1
1.1 Motivation	1
1.2 Structure of Thesis	2
2 Examples of Digital Camera Systems	5
2.1 1Megapixel Motion Picture Camera Systems	7
2.2 Standard Television Camera Systems	8
2.3 Digital Still Camera Systems	9
3 System Overview	11
3.1 Basic Camera System	13
3.2 Sensor Considerations	14

3.2.1	CCD versus CMOS image sensors	14
3.2.2	One versus Three Image Sensors	16
3.2.3	Comparison of CCD Sensor Architectures	17
3.3	Specifications for the EIM camera system	21
3.4	System Partitioning	22
3.5	Comparison of Camera Systems	25
4	Front-end Design	27
4.1	Front-end Overview	27
4.2	CCD Driver Stage Architectures	30
4.2.1	Power Calculations for the CCD Sensor	32
4.2.2	Driver Principles	34
4.2.3	Charge-Pump Solutions for the Frame Pulse	38
4.2.4	Driver Stage Implementation Variants	39
4.2.5	Driver Stage Realizations	41
4.3	Pulse Generator Architectures	52
4.3.1	ZATHRAS: a Combined Pulse Generator and Transmitter ASIC	56
5	Control and Data Link between Front-end and Back-end	59
5.1	Clocking Strategies	60
5.2	Clock and Data Recovery Issues	64
5.3	Link Signaling Comparisons	65
5.4	Realized Transmitter and Receiver Modules	66
5.5	Data and Control Transmission in EIM camera system	68

6	Back-end Design	71
6.1	Correction of CCD and CDS effects	73
6.1.1	Dark Current Compensation and White Gain Adjustment	73
6.1.2	Effects Introduced by the CCD Signal Processor . . .	74
6.2	CFA to RGB Interpolation Algorithms	75
6.2.1	Nearest Neighbor Replication	93
6.2.2	Bilinear Interpolation	93
6.2.3	Smooth Hue Transition Linear Exposure Space	94
6.2.4	Smooth Hue Transition Logarithmic Exposure Space .	95
6.2.5	Reduction of Smooth Hue Interpolation to Two Lines .	96
6.2.6	Edge Sensing Interpolation	97
6.2.7	Enlarged Pixel Neighborhood Interpolation	98
6.2.8	Decision and Final Remarks	101
6.3	From RGB to True Color	102
6.4	LEELOO DALLAS MULTICHIP: a Real-Time CCD Signal Processor	104
7	Conclusions	119
7.1	Realized EIM Camera System	119
7.2	Outlook	122
A	Transistor Types and Symbols	123
B	Temperature and Power Consumption	125

C Noise and Dark-Current Calculations for CCD Image Sensors	127
D Basic Power Estimations for the CCD sensor	131
Curriculum Vitae	137