Table of Contents

Abstract(Chinese)	 i
Abstract(English)	 ii
Acknowledge	 iii
Table of Contents	 iv
Figure Caption	 vi
List of Tables	 ix

Chapter 1	Introduction	
1.1	Introduction	1
1.2	Objective	2
1.3	Organization	3
Chapter 2	Prior Arts of Image Registration and HDR Application	
2.1	Introduction	4
2.2	The Basic Concept of Image Registration Algorithm	4
2.2.1	Aerial Image Analysis	4

2.2.1	Aerial Image Analysis	4
2.2.2	Zhong Zhang's Algprithm	6
2.2.3	WC. Kao's Algorithm	10
2.2.4	Ward's Algorithm	11
2.2.5	Comparison	13
2.3	The basic Concept of Image Fusion for HDR Image	14
2.3.1	The Definition of HDR	14
2.3.2	Nonlinear Mapping in Camera	17
2.3.3	HDR Image Recovering Using Exposure Times	18
2.4	Summary	19

Chapter 3	Proposed Image Registration Algorithm	
3.1	Introduction	20
3.2	Experiment Models	20
3.2.1	Laboratory	20
3.2.2	Outdoors	24
3.3	Proposed Model	27
3.3.1	The Issues of Ward's Algorithm	27
3.3.2	Our Proposed Algorithm	29
3.4	Summary	31

Chapter 4	Proposed Image Fusion Algorithm for HDR	
4.1	Introduction	32
4.2	Our Improved Algorithm for HDR	32
4.2.1	Camera Response Curve	32
4.2.2	Weighting Function	37
4.2.3	Combination	39
4.3	Summary.	41
	The state of the s	

Chapter 5	Experimental Results	
5.1	Instrument and Experiment Flow	42
5.2	Results	44
5.2.1	Image Registration	44
5.2.2	HDR Fusion	49
5.3	Summary	57

Chapter 6	Conclusions and Future Works	
6.1	Conclusions	58
6.2	Future Works	59
References		60

Figure Caption

Fig. 1-1	Image pipeline stage of DSCs	3
Fig. 2-1	Geometry of aerially remote measurement. Images are taken by a	
	down-looking camera at time t1 and t2	5
Fig. 2-2	(a) The mask and its relative position, z _i . (b)Sobel, (c)Prewitt, and	
	(d)Roberts are three different masks and their gradients	7
Fig. 2-3	(a) The target image. The patterns of edges are filtered by (b)Sobel,	
	(c)Prewitt, (d)Roberts, and (e)Canny masks	8
Fig. 2-4	(a) The target image. (b) The pattern of its edges. (c) The pattern of its	
	stronger edges	9
Fig. 2-5	The Bayer pattern	10
Fig. 2-6	Two images with (a) high exposure and (b) low exposure	12
Fig. 2-7	(a) The MTB pattern of Fig. 2-6 (a). (b) The MTB pattern of Fig. 2-6	
	(b)	12
Fig. 2-8	The pyramid decomposition of estimating GMV	
Fig. 2-9	The portrait taken by the user inside the building of bright	
	background	15
Fig. 2-10	Two images with different exposure settings: (a) low exposure and (b)	
	high exposure	16
Fig. 2-11	Image acquisition pipeline	18
Fig. 2-12	The flow chart of fused concept	19
Fig. 3-1	The configuration of the verified model	21
Fig. 3-2	Images are taken by different position. (a)The fixed image. (b)The image	
	of 30mm-shift along the +x direction	21
Fig. 3-3	Images are with different exposures. (a) is -1EV and (b) is +1EV	22
Fig. 3-4	Camera is shifted by x direction. The reference image is fixed and the test	
	images are shifted from -30mm to 30mm	23
Fig. 3-5	Camera is shifted along y direction. The reference image is fixed and the	
	test images are shifted from -30mm to 30mm	23
Fig. 3-6	Two images are taken outdoors. (a) The fixed image and (b) the image of	
	25mm-shift along the +x direction	24

Fig. 3-7	Camera is shifted along the x direction and the shifted pixels from	
	Ward's algorithm are between -2 and 2	25
Fig. 3-8	The result is divided into near scene, far scene, and whole scene	26
Fig. 3-9	Two of sequential images with another background. (a) The fixed image	
	and (b) the image of 25mm- shift along the +x direction	26
Fig. 3-10	Result is divided into near scene, far scene, and whole scene	27
Fig. 3-11	The procedure of block motion detection	30
Fig. 3-12	The image is cut by macro blocks. Some blocks are located in uniform	
	regions (sky and lake) and some are located in complicated areas (trees)	31
Fig. 4-1	Two images with different exposures. (a) High exposure and (b) low	
	exposure	35
Fig. 4-2	The cross-histogram of comparametric equation	36
Fig. 4-3	The camera response curve. Vertical axis is the pixel value with 12-bit	
	and parallel axis is log(q)	36
Fig. 4-4	The weighting functions of low and high exposures respectively	37
Fig. 4-5	The weighting functions of q domain	38
Fig. 4-6	The weighting image of figure 4-4(a) which is normalized to 8-bits	38
Fig. 4-7	Our improved weighting functions of q domain.	39
Fig. 4-8	Our improved weighting image of figure 4-1(a) which is normalized to	
	8-bit	39
Fig. 4-9	The HDR image with discontinuous region in the sky	40
Fig. 4-10	Two response curves of high and low exposures on q domain	40
Fig. 4-11	Three curves of q, q^{ν_3} , and $\log(q)$ vs. f(q)	41
Fig. 5-1	Our experiment flow	42
Fig. 5-2	Our examination flow	43
Fig. 5-3	(a)The CPT building with people. (b)The building shadow. (c)The person	
	in front of a distant background. (d)The person in front of a complicated	
	background. (e)The person inside the building. (f)The seaport with	
	sunset	44
Fig. 5-4	Two fused images with averaging. (a) Ward's algorithm and (b) our	
	proposed algorithm	46
Fig. 5-5	Two images of color checker which is the near scene. The shifted pixels	
	in (a) is (-3,-1) from Ward's algorithm and in (b) is (-5,-1) from our	

proposed algorithm...... 46

- An example of image registration. (a) The fixed image with high **Fig. 5-7** exposure. (b) The shifted image with low exposure. (c)(d) The averaged images of Ward's and our proposed algorithms respectively. (e) The near scene of Ward's algorithm and the shifted pixels are (-6,1). (f) The near scene of our proposed algorithm and the shifted pixels are (-5,-1). (g) The far scene of Ward's algorithm and the shifted pixels are (-6,1). (h) The far scene of our proposed algorithm and the shifted pixels are (-7,-4)..... 48 Fig. 5-8 Fig. 5-9 The scenes of strong backlighting condition with beautiful sky...... 51 **Fig. 5-10** Fig. 5-11 The scenes of the backlighting condition with building shadow...... 53 The scenes of the backlighting condition with building shadow...... 54 Fig. 5-12 **Fig. 5-13** The scenes of the near people in front of building...... 55 **Fig. 5-14** Fig. 6-1 (a) Three images with the same scene but with more noise. (b) High quality image with fewer noise after filtering (a)...... 59

List of Tables

Table 2-1	The comparison of Zhang's, WC. Kao's, and Ward's methods	14
Table 3-1	The list of issues and their causes and improved methods	28
Table 4-1	List the useful examples of camparametric equations and their solutions	
	which are also the camera response curves [15]	34
Table 5-1	The comparison of ADV between Ward's algorithm and our proposed	
	algorithm	45
Table 5-2	The parameters, A and C, of six scenes	49

