

TABLE OF CONTENTS

	Page
PREFACE	iii
TABLE OF CONTENTS	v
LIST OF FIGURES	vii
LIST OF TABLES	ix
LIST OF ACRONYMS	x
ABSTRACT	1
1. INTRODUCTION	1
1.1 Background	2
1.2 Automated Video Quality Measurement System Overview . .	4
2. DESCRIPTION OF FEATURES	6
2.1 Common Video Compression Artifacts	6
2.2 Desirable Properties of Features	9
2.3 Alignment Of Original And Distorted Video Imagery .	11
2.3.1 Single-frame Temporal Alignment	11
2.3.2 Multi-frame Temporal Alignment	13
2.4 Preconditioning Of The Sampled Video	17
2.5 Spatial Blurring Features	18
2.5.1 Feature Extraction Technique	18
2.5.2 Sample VTC/VT Results	22
2.6 Blocking, Edge Busyness, and Image Persistence Features	32
2.6.1 Feature Extraction Technique	33
2.6.2 Sample VTC/VT Results	37
2.7 Jerkiness Feature Using Position Errors	42
2.7.1 Feature Extraction Technique	43
2.7.2 Sample VTC/VT Results	46

2.8	Jerkiness Feature Using Difference Image	59
2.8.1	Feature Extraction Technique	60
2.8.2	Sample VTC/VT Results	62
3.	CONCLUSIONS AND RECOMMENDATIONS	66
4.	ACKNOWLEDGEMENTS	68
5.	REFERENCES	68
6.	BIBLIOGRAPHY	71
7.	APPENDIX A: EQUATIONS	72
8.	APPENDIX B: FILTERS	80

LIST OF FIGURES

	Page
Figure 1. Automated video quality measurement system.	5
Figure 2. Single-frame and multi-frame alignment.	15
Figure 3. Error difference images (input-output) of Figure 2.	16
Figure 4. Camera interlace effects caused by horizontal motion.	20
Figure 5. VTC/VT imagery containing rotational motion.	23
Figure 6. Sobel filtered edge extracted VTC/VT imagery of Figure 5.	25
Figure 7. VTC/VT imagery containing upper body motion.	27
Figure 8. Leftmost column of Figure 7 expanded.	28
Figure 9. Sobel filtered edge extracted VTC/VT imagery of Figure 7.	30
Figure 10. Sobel filtered edge extracted VTC/VT imagery of Figure 8.	31
Figure 11. VTC/VT imagery of moving black ring against white background.	38
Figure 12. Sobel difference image of Figure 11.	39
Figure 13. Sobel difference imagery of Figure 7.	41
Figure 14. Four sequential VTC/VT images for a horizontally moving ball.	48
Figure 15. Four sequential VTC/VT images for a diagonally moving ball.	50
Figure 16. Positions of moving ball as a function of field number for fast motion at the horizontal angle.	52
Figure 17. Positions of moving ball as a function of field number for fast motion at the diagonal angle.	53
Figure 18. The aligned motion paths for the diagonal case in Figure 17.	54
Figure 19. TRMS-PE plotted as a function of horizontal ball speed for code rates of 1/4 DS1 and DS1	57
Figure 20. TRMS-PE plotted as a function of code rate for the fast speed group and diagonal motion.	58
Figure 21. Difference images for VTC/VT imagery of Figure 7.	63

LIST OF TABLES

Page	
Table 1. Common Video Compression Artifacts	8
Table 2. Spatial Blurring Features For VTC/VT Imagery Of Figure 6	26
Table 3. Spatial Blurring Features For VTC/VT Imagery Of Figure 9	32
Table 4. Spatial Blurring Features For Figure 12	40
Table 5. False Edge Features For Figure 12	40
Table 6. Spatial Blurring Features For Figure 13	42
Table 7. False Edge Features For Figure 13	42
Table 8. Summary Of TRMS-PE Results	56
Table 9. Summary Of SD-DI Features For Figure 22	66