

TABLE OF CONTENTS

CHAPTER I	INTRODUCTION.....	1
1	IMAGE FORMATION IN THE HUMAN EYE	4
1.1	Optical transfer function and wave aberration	4
1.2	Aberrations in the human eye.....	5
1.3	Zernike representation of wave aberrations	7
1.4	Global metrics to evaluate optical quality in the human eye	9
2	ABERRATIONS MEASUREMENTS IN THE HUMAN EYE	11
2.1	Measurements of total aberrations.....	11
2.2	Measurements of corneal aberrations	12
3	SOURCES OF ABERRATIONS ON THE HUMAN EYE.....	13
3.1	Intraocular distances, tilts and decentrations.....	14
3.2	Surface shapes	14
3.3	Refractive index.....	15
3.4	Combined measurements of corneal and total aberrations	16
4	OPHTHALMIC AND CLINICAL APPLICATIONS	17
4.1	Biological, ocular changes and pathologies	17
4.2	Ocular surgery	19
4.3	Ophthalmic lenses design and testing.....	20
5	GOALS OF THIS THESIS.....	21
6	REFERENCES	23
CHAPTER II	METHODS.....	28
1	MEASUREMENT OF TOTAL ABERRATIONS	30
1.1	Laser ray tracing technique	30
2	VIRTUAL RAY TRACING AND EYE MODELLING	34
2.1	Virtual ray tracing.....	34
2.2	Eye modelling using Zemax.....	35
3	MEASUREMENT OF CORNEAL ABERRATIONS.....	36
3.1	Videokeratoscope data	36
3.2	Modelling the corneal surface	38
3.3	From corneal surface to corneal wave aberration.....	39
3.4	Additional considerations in ray tracing through corneal surfaces	40
4	INTERNAL ABERRATIONS ESTIMATION	47
5	ACCURACY AND PRECISION: SOURCE OF ERRORS	48
5.1	Bias errors: Accuracy.....	48
5.2	Precision errors	53
5.3	Combining bias and precision errors	54
5.4	Errors in internal aberration estimation	55
6	SOFTWARE FOR CORNEAL FITTING AND ABERRATION COMPUTATION	55
7	PROTOCOLS IN SUBJECT MEASUREMENTS.....	57
8	REFERENCES	57

CHAPTER III VALIDATION OF THE ESTIMATION OF CORNEAL ABERRATIONS FROM VIDEOKERATOGRAPHY: A TEST ON KERATOCONUS EYES60

1	INTRODUCTION	63
2	PATIENT AND METHODS	64
3	RESULTS	67
4	DISCUSSION	70
5	REFERENCES	71

CHAPTER IV CORNEAL AND TOTAL OPTICAL ABERRATIONS IN A UNILATERAL APHAKIC SUBJECT74

1	INTRODUCTION	77
2	PATIENT AND METHODS	78
3	RESULTS	80
4	DISCUSSION	83
5	REFERENCES	85

CHAPTER V OPTICAL RESPONSE TO MYOPIC LASIK SURGERY FROM TOTAL AND CORNEAL ABERRATION MEASUREMENTS ...88

1	INTRODUCTION	91
2	PATIENT AND METHODS	92
3	RESULTS	93
4	DISCUSSION	100
5	REFERENCES	105

CHAPTER VI ON-EYE MEASUREMENT OF OPTICAL PERFORMANCE OF RIGID GAS PERMEABLE CONTACT LENSES BASED ON OCULAR AND CORNEAL ABERROMETRY108

1	INTRODUCTION	111
2	SUBJECT AND METHODS	112
3	RESULTS	116
4	DISCUSSION	121
5	REFERENCES	124

CHAPTER VII OPTICAL ABERRATIONS OF INTRAOCULAR LENSES MEASURED IN VIVO AND IN VITRO126

1	INTRODUCTION	129
2	METHODS	131
3	RESULTS	136
4	DISCUSSION	142
5	CONCLUSIONS	150
6	REFERENCES	151

CHAPTER VIII GLOBAL OPTIMIZATION STRATEGIES IN RAY TRACING DEFLECTION TOMOGRAPHY: ACCURACY AND POSSIBILITIES FOR EVALUATING THE GRADIENT-INDEX IN CRYSTALLINE LENSES 154

1	INTRODUCTION	157
2	METHODS	159
3	RESULTS	167
4	DISCUSSION	171
5	CONCLUSIONS	172
6	REFERENCES	173

CHAPTER IX CONCLUSIONS176

APENDIX A CURRICULUM VITAE181