

TABLE OF CONTENTS

LIST OF FIGURES	v
LIST OF TABLES	xiii
LIST OF ABBREVIATIONS AND SYMBOLS	xv
PREFACE	xvii
CHAPTER 1	1
Introduction	1
1.1 Perception of the Visual World:	1
1.2 Different factors affecting Visual Perception	6
1.2.1 External Factors	6
1.2.2 Internal Factors	13
1.3 Objectives of the Current Investigations:	23
CHAPTER 2	27
Alterations in Visual-Spatial Perception due to change in Autonomic Nervous System Activation	27
2.1 Introduction:	27
2.2 Formulation of the Quantitative Framework	31
2.2.1 The Geometry of Perceived visual space	31
2.2.2 Parameter for Representing the Alterations:	36
2.2.3 Dynamics of the Neuromodulating Agents in the Brain	40
2.2.4 Neural Correlates	43
2.2.4.1 Multi-Modal Sensory Perception System	43
2.2.4.2 Mapping of Visual Space by Grid Cells based Motif	45
2.2.4.3 Neuro-computational Model of Drug-Induced Perceptual Alterations ..	48
2.3 Experimental Validation of Quantitative Framework	54
2.3.1 Methodology	54
2.3.1.1 Dynamics of Psilocybin	54

2.3.1.2 Dynamics of Chlorpromazine	55
2.3.1.3 Diffusion MRI Experiment	56
2.3.1.4 Computational Model of a Grid Cell Network.....	57
2.3.1.5 Measurement of Visual Space Under Hyper-Activation	59
2.3.1.6 Spatial Distortion Threshold Under Hyper-Activation	61
2.3.1.7 Spatial Perception Under Hypo-Activation	62
2.3.2 Results.....	62
2.3.2.1 Visual Space under the Psilocybin-Induced Hyper-Activation	62
2.3.2.2 Relation between Drug Concentration and Perceptual Alterations.....	66
2.3.2.3 Prediction of Metric Tensor under Psilocybin-Induced Hyper- Activation.....	70
2.3.2.4 Visual Space under Chlorpromazine-Induced Hypo-Activation	72
2.3.2.5 Anatomical Connectivity between the Entorhinal Cortex and Area V2	75
2.3.2.5.1 Three Tesla MRI.....	75
2.3.2.5.2 Seven Tesla MRI	78
2.3.2.6 Grid Cell Activity under Drug-Induced Perceptual Alterations	79
2.3.2.6.1 During Normal Conditions (No Drug Condition)	79
2.3.2.6.2 Under Drug-Induced Neural Activation	80
2.3.2.6.3 Quantification of the drug-induced neural activation	85
2.4 Discussion	88
2.4.1 Quantitative Model	88
2.4.2 Verification by Empirical Finding	89
2.4.3 Practical Perspective:	90
2.4.4 Neuron-Level Processes:	91
2.4.5 Spectrum of Perceptual Modulation:.....	92
2.4.6 Biomedical Implications:.....	93
CHAPTER 3	95
Visual Perception of the Moving Object.....	95

3.1 Introduction	95
3.2. Our Mathematical Analysis.....	98
3.2.1 Geometrical Representation of Moving Object	98
3.2.2 Mapping Coordinate Transformations Between Retinotopic Space and Perceptual Space	100
3.2.3 Coordinate Transformation Matrix:.....	102
3.2.4 Generalization of Coordinate Transformation Matrix:.....	104
3.2.5 Relationship between Spatial Coordinates in Perceptual Space and Retinotopic Space.....	105
3.2.6 Translation to the Neural System.....	109
3.3. Empirical Validation of the Mathematical Analysis	112
3.3.1 Methods.....	112
3.3.1.1 Moving Arc	112
3.3.1.2 Temporal Perception	113
3.3.2 Results.....	114
3.3.2.1 Perception of a Moving Arc	114
3.3.2.2 Perception of Time	118
3.4 Anatomical Correlates	121
3.4.1 Conceptual Observations	121
3.4.2 Diffusion MRI Tractography Experiment.....	123
3.4.2.1 Methods.....	123
3.4.2.2 Results	125
3.5. Proposed Neuronal Level Mechanism.....	136
3.6 Formal Analysis of the Perception of Moving Object.....	141
3.7 Discussions	146
3.7.1 Mathematical Model.....	146
3.7.2 Anatomical Correlates.....	147
3.7.3 Neuronal Framework	148
3.7.4 General Significance and Applicability	150

Chapter 4	151
Conclusion and Future Scope	151
4.1 Internal Factor	153
4.2 External Factor	157
4.3 Future Prospects	160
References	165
Appendix-A	205
List of Publications during Ph.D. Program	237