

Contents

1	Introduction	1
I	Computational Modeling	3
2	A Model of Salient Region Detection	5
2.1	Introduction	5
2.2	Saliency-based Bottom-up Attention	7
2.3	Attending Proto-object Regions	10
2.4	Discussion	12
2.5	Outlook	14
3	Modeling the Deployment of Spatial Attention	17
3.1	Introduction	17
3.2	Model	17
3.2.1	Object Recognition	19
3.2.2	Attentional Modulation	20
3.3	Experimental Setup	20
3.4	Results	22
3.5	Discussion	25
4	Feature Sharing between Object Detection and Top-down Attention	27
4.1	Introduction	27
4.2	Model	28
4.2.1	Feature Learning	28
4.2.2	Object Detection	30
4.2.3	Top-down Attention	31
4.3	Experimental Setup	31
4.4	Results	33
4.5	Discussion	36

II Machine Vision	39
5 Attention for Object Recognition	41
5.1 Introduction	41
5.2 Approach	42
5.3 Selective Attention versus Random Patches	45
5.3.1 Experimental Setup	46
5.3.2 Results	48
5.4 Learning Multiple Objects from Natural Images	49
5.4.1 Experimental Setup	49
5.4.2 Results	50
5.5 Objects in Cluttered Scenes	53
5.5.1 Experimental Setup	53
5.5.2 Results	55
5.6 Discussion	58
6 Detection and Tracking of Objects in Underwater Video	61
6.1 Introduction	61
6.2 Motivation	62
6.3 Algorithms	63
6.3.1 Background Subtraction	63
6.3.2 Detection	63
6.3.3 Tracking	67
6.3.4 Implementation	70
6.4 Results	71
6.4.1 Single Frame Results	71
6.4.2 Video Processing	72
6.5 Discussion	72
III Psychophysics	75
7 Measuring the Cost of Deploying Top-down Visual Attention	77
7.1 Introduction	77
7.2 Methods	79
7.2.1 Subjects	79
7.2.2 Apparatus	79
7.2.3 Stimuli	79

7.2.4	Experimental Paradigm	80
7.2.5	Data Analysis	82
7.3	Results	83
7.4	Discussion	86
8	Conclusions	89
8.1	Summary	89
8.2	Future Work	90
Appendix		94
A	Implementation Details	95
A.1	Creating the Gaussian Pyramid	95
A.2	Color Opponencies for Bottom-up Attention	98
A.3	Motion as a Salient Feature	100
A.4	Skin Hue Detection	103
B	The SaliencyToolbox	107
B.1	Introduction	107
B.2	Installation	109
B.3	Quick Start	109
B.4	Compilation	110
B.4.1	Linux, Mac OS X, and other Unix flavors	110
B.4.2	Microsoft Windows	110
B.5	Generating the Documentation	111
References		113

