Contents

	page
Abstract	*v*
Acknowledgments	*vii*
Contents	*ix*
List of Figures	*xi*
List of Tables	*xiii*
List of Symbols	*xv*
List of Abbreviations	*xvii*
Chapter 1: Introduction	1
1.1 Motivation	1
1.2 Scope of the thesis	1
1.3 Research Objectives	3
1.4 Contributory Overview and Organization of the thesis	3
Chapter 2: Background and Literature Survey	7
2.1 Stochastic Resonance	7
2.1.1 Generic double-well model of Stochastic Resonance	*8*
2.1.2 Related work in Stochastic Resonance	*9*
2.2 Image denoising	11
2.2.1 Related work in image denoising	*11*
2.3 Edge detection	13
2.3.1 Related work in edge detection	*13*
Chapter 3: Noise-enhanced edge-preserving image denoising	15
3.1 Key Contribution	15
3.2 Proposed analogy for double well for image denoising application	16
3.3 Proposed framework for SR-based edge-preserving denoising	17
3.3.1 Initial similarity calculation	*18*
3.3.2 SR-based Iterative Processing of Similarity Matrix	*20*
3.3.3 Final Aggregation Process	*21*
3.3.4 Finding the optimally-denoised output image	*21*
3.3.5 Experimental procedure	*21*
3.3.6 Computational Complexity	*22*
3.4 Results and Discussions	23
3.4.1 SR-NLM vs. NLM	*23*
3.4.2 How exactly does SR help in denoising here?	*28*
3.4.3 Comparative Characterization	*30*
3.5 Conclusion and Limitations	33
Chapter 4: Exhibition of noise-induced threshold crossing by discontinuity detectors in smartphone images	35
4.1 Key Contribution	35
4.2 AWGN vs. Cameraphone noise	36
4.3 General Detection model for Intrinsic Smartphone Noise	36
4.4 Manifestation of SR in Corner Detectors	39
4.4.1 Constant threshold, Varying noise	*39*
4.4.2 Varying threshold, constant noise	*41*
4.5 SR Manifestation in Line Detectors	41
4.5.1 Constant threshold, varying noise	*42*
4.5.2 Varying threshold, constant noise	*43*
4.6 SR Manifestation in Edge Detectors	43
4.6.1 Constant threshold, varying noise	*43*
4.6.2 Varying threshold, constant noise	*46*
4.7 Conclusion	47

Chapter 5: Enhanced edge detection using SR-guided threshold maneuvering and window mapping in Canny edges 49
5.1 The problem under consideration 50
5.2 Key Contribution 51
5.3 Edge Detector with changing threshold in Smartphone images 52
5.3.1 How is the proposed framework informed by SR? *52*
5.4 Proposed Algorithm: SR-guided enhanced Canny Edge Detector using Thresholding maneuvering and Window mapping (SR-TW-CED) 52
5.4.1 Channel Separation *52*
5.4.2 CED steps *54*
5.4.3 Raw Window Mapping *54*
5.4.4 Processed Window Mapping *54*
5.4.5 Adapt T_l and T_h *55*
5.4.6 Combine R-G-B edge content *55*
5.4.7 Extract Edge Content from R G B channels *55*
5.4.8 Edge Flags & Noise Flags *56*
5.5 Results & Discussion 58
5.5.1 Evaluation metrics used *58*
5.5.2 Results with pristine image *59*
5.5.3 Two versions of the proposed SR-TW-CED *59*
5.5.4 Effect of changing input threshold *60*
5.5.5 Comparison with other algorithms *63*
5.5.6 BSDS500 & BIPED benchmarking *64*
5.6 Conclusion and Limitations 67

Chapter 6: A precision-boosting plug-and-play post-processing edge filter 69
6.1 The problem under consideration 69
6.2 Key contributions 71
6.3 Utility 71
6.4 Proposed Algorithm for Precision-Boosting Edge Filter: PB-Edge-Filter 72
6.4.1 Triple-window patch-debias broken-hysteresis framework *74*
6.4.2 Filtering units *77*
6.5 Ablation study 77
6.6 Results and Discussions 79
6.6.1 Analysis on BIPED dataset *82*
6.6.2 Comparison with other edge post-processing algorithms *83*
6.7 Conclusion and Limitations 85

Chapter 7: Conclusions 87
7.1 Limitations and Future Scope 91

Bibliography 93

List of Publications 101