LIST OF FIGURES

Figure 1.1:	General block diagram of image reconstruction	4
Figure 1.2:	Block diagram of noisy measured data	5
Figure 2.1:	A classification of different medical imaging modalities with respect to the type of energy source used for imaging	11
Figure 2.2:	General Block diagram of a typical modern electronic medical imaging system	13
Figure 2.3:	The coincidence data detected in each LOR estimate the activity density in the image.	16
Figure 2.4:	Classifications of Tomographic Image Reconstruction Techniques	18
Figure 2.5:	The 1D projection at angle θ, is an integral of the object distribution f(x, y) along the s direction.	19
Figure 2.6:	The Fourier slice theorem.	20
Figure 2.7:	(a) Original Shepp-Logan head Phantom, 256 × 256. (b) Sinogram over 1000 projections, (c) Reconstruction obtained without filter, (d)-(h) Reconstructed image over 180 degrees: (d) 50, (e) 100, (f) 300, (g) 500, and (h) 1000 projections by FBP	24
Figure 2.8:	Reconstruction process in algebraic method.	25
Figure 2.9:	The phantoms used in the simulation study, (a) Modified Shepp-Logan phantom (128×128 pixels), (b) PET Test phantom (128×128 pixels), (c) SPECT Test phantom (128×128 pixels), (d) Medical thorax image (128×128 pixels).	57
Figure 2.10:	Modified Shepp-Logan phantom	57
Figure 2.11:	PET Test phantom	58
Figure 2.12:	SPECT Test phantom	58
Figure 2.13:	Medical thorax image	59
Figure 3.1:	The proposed Hybrid Model (MLEM+AD)	71
Figure 3.2:	Modified Sheep-Logan mathematical phantom (64x64pixels) & Standard thorax medical image (128x128 pixels)	73
Figure 3.3:	The PET test Phantom with different reconstruction methods. Projection including 10% uniform Poisson distributed background events.	74
Figure 3.4:	The Plots of SNR, RMSE, CP, and MSSIM along with Iterations for	74

Test case 1.
Figure 3.5: Line Plot of simulated PET test Phantom and standard Thorax phantom images using proposed MLEM+AD method
Figure 3.6: The SPECT elliptical Test Phantom with different reconstruction methods. Projection including 10% uniform Poisson distributed background events. 75
Figure 3.7: The Plots of SNR, RMSE, CP, and MSSIM along with Iterations for Test case 2. 75
Figure 3.8: Modified Sheep-Logan mathematical phantom (64x64pixels) & Standard thorax medical image (128x128 pixels) 85
Figure 3.9: The modified Shepp-Logan phantom image reconstructed by different algorithms: (a) SART, (b) MLEM, (c) MRP, (d) MLEM+AD 86
Figure 3.10: The Plots of SNR, PSNR, CP, and MSSIM along with No. of Iterations for different reconstruction algorithms. 87
Figure 3.11: Line Plots of reconstructed Modified Shepp-Logan Phantom image using proposed (MLEM+AD) and other methods 87
Figure 3.12: The real thorax phantom image reconstructed by different algorithms: (a) SART, (b) MLEM, (c) MRP, (d) MLEM+AD 88
Figure 3.13: Line Plots of reconstructed Standard Thorax image using proposed (MLEM+AD) and other methods 88
Figure 4.1: Generalized Hybrid-Cascaded Framework for PET/SPECT Image Reconstruction 91
Figure 4.2: Proposed MLEM based hybrid-cascaded framework (Model-1) 100
Figure 4.3: The phantoms used in the simulation study, (a) Modified Shepp-Logan phantom (128×128 pixels), (b) PET Test phantom (128×128 pixels), (c) SPECT Test phantom (128×128 pixels), (d) Medical thorax image (128×128 pixels) 108
Figure 4.4: The Modified Shepp-Logan phantom with different reconstruction methods. Projection including 15% uniform Poisson distributed background events. 109
Figure 4.5: The Plots of SNR, RMSE, CP and MSSIM along with No. of Iterations for different reconstruction algorithms for Test case 1. 110
Figure 4.6: Line Plot of Shepp-Logan Phantom 110
Figure 4.7: The PET test phantom with different reconstruction methods includ- 111

ing 15% uniform Poisson noise.
Figure 4.8: Line Plots of reconstructed PET Test Phantom using proposed (SART+MLEM+mAD) and other methods 111
Figure 4.9: The SPECT test phantom with different reconstruction methods including 15% uniform Poisson noise. 112
Figure 4.10: Line Plots of reconstructed Elliptical Test Phantom using proposed (SART+MLEM+MedAD) and other methods 112
Figure 4.11: The Real thorax phantom with different reconstruction methods including 15% uniform Poisson noise. 113
Figure 4.12: Line Plots of reconstructed Standard Thorax medical Test image using proposed (SART+MLEM+MedAD) and other methods 113
Figure 4.13: Proposed MRP based hybrid-cascaded framework (Model-2) 118
Figure 4.14: The phantoms used in the simulation study, (a) Modified Shepp Logan phantom, (b) Medical thorax image 121
Figure 4.15: The Modified Shepp-Logan phantom with different reconstruction methods. 121
Figure 4.16: The standard thorax medical image with different reconstruction methods. 121
Figure 4.17: The Plots of SNR, RMSE, CP and MSSIM along with No. Iterations 122
Figure 4.18: Line Plot of Shepp-Logan phantom and standard thorax medical image using Proposed method (SART+MRP+AD) with other methods 122
Figure 4.19: Proposed OSEM based hybrid-cascaded framework (Model-3) 128
Figure 4.20: The phantoms used in the simulation study, (a) Modified Shepp-Logan phantom (64 x 64 pixels), (b) PET Test phantom (64 x 64 pixels), (c) SPECT Test phantom (64 x 64 pixels), (d) Medical thorax image (128x128 pixels) 133
Figure 4.21: The Modified Shepp-Logan phantom with different reconstruction methods including 15% uniform Poisson noise. 134
Figure 4.22: The Plots of SNR, RMSE, PSNR, CP, and MSSIM along with No. of Iterations. 135
Figure 4.23: Line Plot of Shepp-Logan phantom using Proposed method (SART+OSEM+AD) with other methods 136
Figure 4.24: The PET test phantom with different reconstruction methods including 15% uniform Poisson noise.. 136
Figure 4.25: Line Plot of PET Test phantom using Proposed method 137

(SART+OSEM+AD) with other methods

Figure 4.26: The SPECT elliptical Test Phantom with different reconstruction methods including 15% uniform Poisson noise. 137

Figure 4.27: Line Plot of Elliptical Test phantom using Proposed method (SART+OSEM+AD) with other methods 138

Figure 4.28: The standard thorax medical image with different reconstruction methods including 15% uniform Poisson noise. 138

Figure 4.29: Line Plot of Standard Thorax Test phantom image using Proposed method (SART+OSEM+AD) with other methods 139

Figure 4.30: The Plots of SNR along with No. of Iterations 142

Figure 4.31: The Plots of RMSE along with No. of Iterations 142

Figure 4.32: The Plots of CP along with No. of Iterations 143

Figure 4.33: The Plots of MSSIM along with No. of Iterations 143

Figure 4.34: The overall performance measures of Model 1, Model 2, and Model 3 144

Figure 5.1: The phantoms used in the simulation study, Modified Shepp-Logan phantom (128 x 128 pixels), CT Test phantom (128 x 128 pixels) 170

Figure 5.2: The Modified Shepp-Logan phantom with different reconstruction methods from the noise-free and noisy data. Original Shepp-Logan phantom, (b) noise free sinogram (c) noisy sinogram (d) reconstructed image by TV+FBP, (e) reconstructed result by AD+FBP, (f) reconstructed result by CONVEF_AD+FBP 170

Figure 5.3: The CT phantom with different reconstruction methods from the noise-free and noisy data. Original Shepp-Logan phantom, (b) noise free sinogram (c) noisy sinogram (d) reconstructed image by TV+FBP, (e) reconstructed result by AD+FBP, (f) reconstructed result by CONVEF_AD+FBP 170

Figure 5.4: The Plots of SNR along with No. of Iterations for different reconstruction algorithms for Test case 1 171

Figure 5.5: The Plots of RMSE along with No. of Iterations for different reconstruction algorithms for Test case 1 171

Figure 5.6: The Plots of CP along with No. of Iterations for different reconstruction algorithms for Test case 1 172

Figure 5.7 The Plots of MSSIM along with No. of Iterations for test case 1 172