Supplementary File for Conjugate Momentum Quadratic Penalty Alternating Minimization for Total Variation Image Restoration

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I. Test Images

This section serves as an appendix, providing details and results that complement the main file. Figure 1 shows are the tested images used for the experiments that discussed in the subsection V-A.

(a) *Foot* (512 × 512)

(b) *Pepper* (512 × 512)

(c) *Cameraman* (256 × 256)

Fig. 1: Test images used

II. Tables

Table I, provided here presents the comparative results between QPAM, AQPAM, and CG-QPAM under Gaussian and Poisson noise conditions, as discussed in subsection V-C of the main paper.

III. Restored Images

Figure 2 shows the results of the SSIM between QPAM and CG-QPAM for BSNR 30 that discussed in V-C-1.

IV. Figures of CG-QPAM convergence

Figure 3 shows the effects of convergence of CG-QPAM if the parameter α are modified that discussed in the V-C-1.

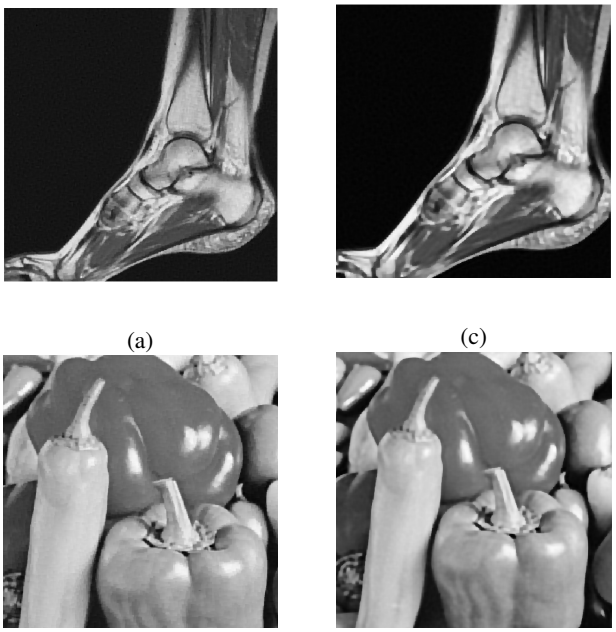
BSNR	Image	Method	PSNR	SSIM	Time (s)	Itr
20	*Pepper*	QPAM	29.665	0.799	3.337	145
		AQPAM	29.282	0.789	2.812	116
		CG-QPAM	**29.829**	**0.812**	**2.763**	**103**
	Foot	QPAM	27.690	0.725	5.726	253
		AQPAM	27.132	0.701	**3.966**	**174**
		CG-QPAM	**27.720**	**0.732**	5.965	259
	Cameraman	QPAM	24.953	0.749	0.901	197
		AQPAM	24.734	0.751	**0.619**	**137**
		CG-QPAM	**24.976**	**0.775**	1.010	185
30	*Pepper*	QPAM	**32.332**	0.841	2.746	109
		AQPAM	31.951	0.838	3.469	98
		CG-QPAM	31.058	**0.847**	**1.968**	**74**
	Foot	QPAM	**29.997**	0.831	4.475	192
		AQPAM	29.439	0.829	**3.223**	**144**
		CG-QPAM	29.076	**0.874**	3.616	149
	Cameraman	QPAM	**27.149**	**0.828**	0.886	159
		AQPAM	27.131	**0.828**	0.501	119
		CG-QPAM	25.526	0.802	**0.482**	**115**
40	*Pepper*	QPAM	**34.456**	**0.877**	1.890	77
		AQPAM	34.090	0.875	1.766	73
		CG-QPAM	30.513	0.821	**0.456**	**11**
	Foot	QPAM	**32.787**	**0.905**	3.707	153
		AQPAM	32.155	0.904	2.532	112
		CG-QPAM	29.953	0.904	**1.386**	**30**
	Cameraman	QPAM	**30.007**	**0.890**	0.726	141
		AQPAM	29.992	**0.890**	0.387	98
		CG-QPAM	25.076	0.765	**0.088**	**17**

(a) Gaussian Noise

Pixel	Image	Method	PSNR	SSIM	Time (s)	Itr
255	*Pepper*	QPAM	**27.584**	**0.761**	9.394	170
		AQPAM	27.113	0.750	4.658	154
		CG-QPAM	24.968	0.734	**0.301**	**9**
	Foot	QPAM	**27.123**	**0.876**	7.434	279
		AQPAM	26.484	0.870	5.633	194
		CG-QPAM	24.833	0.836	**0.251**	**5**
	Cameraman	QPAM	**23.849**	**0.720**	1.079	211
		AQPAM	23.704	**0.720**	0.847	166
		CG-QPAM	24.833	0.836	**0.251**	**5**
400	*Pepper*	QPAM	**24.075**	**0.670**	4.881	174
		AQPAM	23.534	0.656	4.372	158
		CG-QPAM	21.212	0.637	**0.199**	**7**
	Foot	QPAM	**23.815**	**0.865**	7.738	285
		AQPAM	23.061	0.858	5.930	212
		CG-QPAM	20.945	0.810	**0.147**	**5**
	Cameraman	QPAM	**20.358**	**0.663**	1.106	224
		AQPAM	20.225	0.654	0.785	175
		CG-QPAM	17.648	0.588	**0.020**	**4**

(b) Poisson Noise

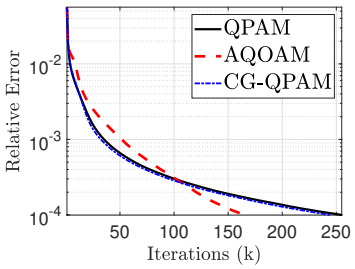
TABLE I: Comparison of methods for *Pepper*, *Foot*, and *Cameraman* images with two different noise types.



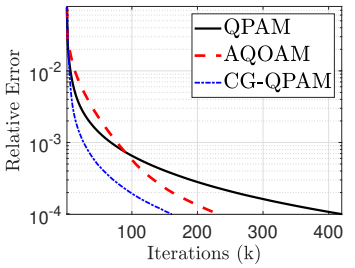
(a) (c)

(b) (d)

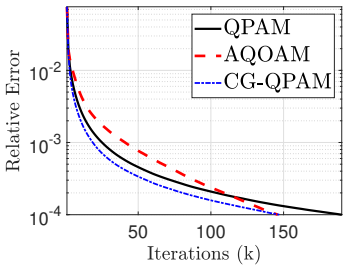
Fig. 2: Restored *Foot* and *Pepper* images at 30 BSNR value with 2 different methods. (a) and (b) are the QPAM restored images. (c) and (d) are the CG-QPAM restored images.



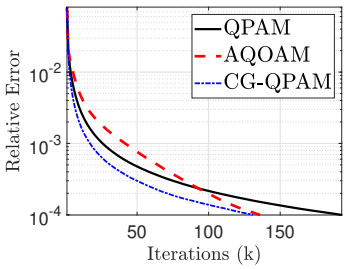
(a)



(b)



(c)



(d)

Fig. 3: (a) and (b) BSNR=20. (c) and (d) BSNR=30. The λ in (a) is 0.9 and (b) is 4.0. The λ in (c) is 5.2 and (d) is 7.0. The value of λ can improve the convergence of the CG-QPAM