

Supplementary File of Chapter 6

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the date of receipt and acceptance should be inserted later

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Table S1: *Results of AEFA variants at th=3.*

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 1	MEAN	1.94E+01	1.98E+01	1.57E+01	1.85E+01	1.84E+01	2.07E+01	2.05E+01	2.09E+01	1.99E+01
	MSE	3.33E+03	1.66E+03	8.96E+03	1.91E+03	4.69E+03	8.16E+03	5.84E+03	1.93E+03	1.14E+04
	STD	3.60E-01	7.23E-01	2.82E-02	1.02E+00	1.01E+00	7.28E-01	7.08E-01	9.22E-01	1.56E+00
	PSNR	1.45E+01	1.62E+01	1.10E+01	1.55E+01	1.34E+01	1.22E+01	1.29E+01	1.70E+01	9.61E+00
	SSIM	5.89E-01	6.26E-01	3.31E-01	6.08E-01	4.75E-01	3.84E-01	4.69E-01	6.57E-01	2.51E-01
	FSIM	7.30E-01	7.49E-01	6.37E-01	7.44E-01	6.78E-01	6.87E-01	6.93E-01	7.64E-01	6.32E-01
Im 2	MEAN	2.05E+01	2.07E+01	1.60E+01	1.97E+01	1.96E+01	2.01E+01	1.96E+01	2.12E+01	2.06E+01
	MSE	3.20E+03	4.90E+03	4.38E+03	3.92E+03	4.48E+03	3.32E+03	3.85E+03	2.76E+03	3.74E+03
	STD	5.10E-01	5.92E-01	1.26E-03	1.01E+00	1.28E+00	3.91E-01	9.54E-02	8.18E-01	1.79E+00
	PSNR	1.37E+01	1.20E+01	1.19E+01	1.25E+01	1.19E+01	1.32E+01	1.29E+01	1.40E+01	1.33E+01
	SSIM	6.52E-01	6.32E-01	5.60E-01	5.80E-01	5.93E-01	5.27E-01	6.25E-01	6.62E-01	6.49E-01
	FSIM	7.83E-01	7.68E-01	7.60E-01	7.76E-01	7.72E-01	7.15E-01	7.50E-01	7.87E-01	7.77E-01
Im 3	MEAN	2.06E+01	2.11E+01	1.60E+01	1.96E+01	1.92E+01	2.11E+01	2.06E+01	2.16E+01	2.08E+01
	MSE	5.40E+03	4.84E+03	5.26E+03	3.30E+03	3.14E+03	2.51E+03	3.62E+03	2.35E+03	3.22E+03
	STD	4.67E-01	7.13E-01	3.01E-02	9.18E-01	8.42E-01	6.69E-01	4.27E-01	7.72E-01	1.13E+00
	PSNR	1.10E+01	1.18E+01	1.15E+01	1.33E+01	1.34E+01	1.42E+01	1.31E+01	1.35E+01	1.47E+01
	SSIM	6.66E-01	6.67E-01	5.83E-01	6.69E-01	6.55E-01	6.60E-01	6.78E-01	6.90E-01	6.89E-01
	FSIM	7.68E-01	7.76E-01	7.38E-01	7.88E-01	7.84E-01	7.84E-01	7.86E-01	7.96E-01	7.93E-01
Im 4	MEAN	1.86E+01	1.99E+01	1.53E+01	1.85E+01	1.87E+01	2.06E+01	1.97E+01	1.98E+01	1.96E+01
	MSE	3.75E+03	4.71E+03	7.71E+03	4.16E+03	4.37E+03	4.22E+03	4.18E+03	5.30E+03	5.32E+03
	STD	4.15E-01	8.55E-01	7.85E-02	1.20E+00	9.84E-01	6.09E-01	7.48E-01	7.68E-01	2.36E+00
	PSNR	1.28E+01	1.18E+01	1.00E+01	1.24E+01	1.20E+01	1.25E+01	1.30E+01	1.10E+01	1.10E+01
	SSIM	5.44E-01	4.78E-01	3.35E-01	4.35E-01	4.10E-01	4.63E-01	4.67E-01	3.93E-01	3.97E-01
	FSIM	6.27E-01	6.32E-01	5.90E-01	6.30E-01	6.20E-01	6.40E-01	6.11E-01	6.13E-01	5.98E-01
Im 5	MEAN	1.93E+01	2.00E+01	1.56E+01	1.90E+01	1.93E+01	2.06E+01	1.96E+01	2.11E+01	2.03E+01
	MSE	5.47E+03	5.22E+03	5.84E+03	4.40E+03	4.51E+03	2.93E+03	3.12E+03	2.63E+03	3.64E+03
	STD	4.53E-01	5.10E-01	3.84E-02	8.99E-01	8.72E-01	7.70E-01	5.76E-01	8.39E-01	1.50E+00
	PSNR	1.12E+01	1.14E+01	1.07E+01	1.20E+01	1.20E+01	1.35E+01	1.37E+01	1.40E+01	1.28E+01
	SSIM	4.86E-01	5.11E-01	3.99E-01	4.14E-01	4.39E-01	4.49E-01	4.98E-01	4.77E-01	4.91E-01
	FSIM	6.44E-01	6.56E-01	5.88E-01	6.28E-01	6.50E-01	6.51E-01	6.64E-01	6.68E-01	6.70E-01
Im 6	MEAN	2.02E+01	2.14E+01	1.58E+01	1.97E+01	1.94E+01	2.24E+01	2.07E+01	2.15E+01	2.16E+01
	MSE	2.09E+03	1.62E+03	5.02E+03	3.66E+03	3.10E+03	2.55E+03	6.59E+03	4.96E+03	5.76E+03
	STD	4.09E-01	8.44E-01	3.71E-02	9.26E-01	8.67E-01	7.64E-01	5.93E-01	8.58E-01	9.24E-01
	PSNR	1.52E+01	1.62E+01	1.30E+01	1.42E+01	1.44E+01	1.57E+01	1.14E+01	1.36E+01	1.25E+01
	SSIM	5.89E-01	6.12E-01	4.32E-01	4.88E-01	5.04E-01	5.73E-01	3.60E-01	4.64E-01	4.02E-01
	FSIM	7.74E-01	8.09E-01	6.84E-01	7.27E-01	7.43E-01	7.96E-01	6.41E-01	7.18E-01	6.84E-01
Im 7	MEAN	2.10E+01	2.04E+01	1.58E+01	1.91E+01	1.94E+01	2.06E+01	2.09E+01	2.09E+01	2.09E+01
	MSE	1.81E+03	2.72E+03	7.71E+03	3.36E+03	2.94E+03	1.14E+04	4.61E+03	8.66E+03	8.10E+03
	STD	4.47E-01	5.33E-01	6.40E-02	8.57E-01	9.69E-01	4.39E-01	8.88E-01	6.53E-01	1.39E+00
	PSNR	1.60E+01	1.47E+01	1.06E+01	1.42E+01	1.53E+01	8.52E+00	1.23E+01	1.06E+01	1.08E+01
	SSIM	2.87E-01	5.51E-01	2.90E-01	5.05E-01	5.67E-01	1.59E-01	4.58E-01	6.37E-01	2.98E-01
	FSIM	7.86E-01	7.63E-01	5.83E-01	7.52E-01	7.59E-01	5.25E-01	6.87E-01	6.13E-01	6.22E-01

Table S2: *Results of AEFA variants at $th=3$.*

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 8	MEAN	1.86E+01	1.92E+01	1.54E+01	1.76E+01	1.72E+01	1.90E+01	1.86E+01	1.91E+01	1.95E+01
	MSE	3.38E+03	2.71E+03	3.83E+03	2.92E+03	3.19E+03	5.63E+03	3.93E+03	4.39E+03	4.02E+03
	STD	3.44E-01	6.00E-01	2.10E-02	9.25E-01	8.31E-01	4.66E-01	4.22E-01	7.36E-01	1.82E+00
	PSNR	1.32E+01	1.43E+01	1.26E+01	1.40E+01	1.33E+01	1.12E+01	1.23E+01	1.19E+01	1.23E+01
	SSIM	5.01E-01	5.94E-01	5.62E-01	5.81E-01	5.73E-01	4.68E-01	5.54E-01	5.99E-01	5.27E-01
	FSIM	6.95E-01	6.95E-01	6.76E-01	6.84E-01	6.84E-01	6.05E-01	6.50E-01	6.31E-01	6.47E-01
Im 9	MEAN	1.87E+01	1.86E+01	1.47E+01	1.69E+01	1.83E+01	1.92E+01	1.90E+01	1.99E+01	1.94E+01
	MSE	3.38E+03	3.73E+03	5.62E+03	3.16E+03	2.77E+03	4.81E+03	4.57E+03	3.07E+03	3.80E+03
	STD	5.41E-01	3.84E-01	6.17E-02	1.06E+00	1.12E+00	6.29E-01	9.20E-01	1.06E+00	1.29E+00
	PSNR	1.33E+01	1.29E+01	1.17E+01	1.35E+01	1.40E+01	1.15E+01	1.23E+01	1.38E+01	1.28E+01
	SSIM	5.74E-01	5.44E-01	5.08E-01	5.82E-01	5.87E-01	5.03E-01	5.10E-01	5.68E-01	5.32E-01
	FSIM	6.85E-01	6.68E-01	6.40E-01	6.82E-01	6.66E-01	6.11E-01	6.42E-01	6.88E-01	6.41E-01
Im 10	MEAN	1.82E+01	1.94E+01	1.61E+01	1.81E+01	1.82E+01	1.86E+01	1.81E+01	1.96E+01	1.92E+01
	MSE	4.97E+03	4.08E+03	5.09E+03	3.98E+03	3.88E+03	8.44E+03	4.84E+03	3.74E+03	6.40E+03
	STD	3.41E-01	8.80E-01	1.54E-01	9.58E-01	5.01E-01	5.65E-01	4.33E-01	1.01E+00	1.28E+00
	PSNR	1.35E+01	1.24E+01	1.12E+01	1.28E+01	1.26E+01	9.71E+00	1.29E+01	1.24E+01	1.11E+01
	SSIM	5.73E-01	5.35E-01	5.22E-01	5.43E-01	5.19E-01	4.09E-01	5.13E-01	5.27E-01	4.62E-01
	FSIM	6.88E-01	6.87E-01	6.79E-01	6.93E-01	6.81E-01	5.98E-01	6.58E-01	6.71E-01	6.35E-01
Im 11	MEAN	1.83E+01	1.84E+01	1.46E+01	1.77E+01	1.76E+01	1.97E+01	1.86E+01	1.97E+01	1.88E+01
	MSE	3.10E+03	3.56E+03	5.75E+03	3.77E+03	3.67E+03	7.27E+03	5.91E+03	3.48E+03	4.39E+03
	STD	2.76E-01	5.97E-01	2.31E-02	9.89E-01	7.85E-01	6.41E-01	6.16E-01	7.94E-01	1.38E+00
	PSNR	1.30E+01	1.33E+01	1.06E+01	1.27E+01	1.30E+01	1.05E+01	1.12E+01	1.38E+01	1.22E+01
	SSIM	5.38E-01	5.83E-01	4.72E-01	5.44E-01	5.34E-01	4.20E-01	4.92E-01	5.90E-01	4.54E-01
	FSIM	7.23E-01	7.17E-01	6.71E-01	7.16E-01	7.12E-01	6.22E-01	6.76E-01	7.12E-01	6.70E-01
Im 12	MEAN	1.79E+01	1.91E+01	1.51E+01	1.77E+01	1.90E+01	1.96E+01	1.83E+01	1.90E+01	1.93E+01
	MSE	6.06E+03	4.11E+03	5.11E+03	3.74E+03	3.81E+03	1.02E+04	3.60E+03	3.21E+03	4.42E+03
	STD	2.99E-01	7.02E-01	4.21E-02	1.10E+00	1.32E+00	5.23E-01	3.68E-01	6.74E-01	1.43E+00
	PSNR	1.36E+01	1.23E+01	1.13E+01	1.28E+01	1.24E+01	8.80E+00	1.32E+01	1.11E+01	1.26E+01
	SSIM	5.54E-01	5.40E-01	4.84E-01	5.38E-01	5.22E-01	3.53E-01	5.62E-01	3.93E-01	4.87E-01
	FSIM	7.01E-01	7.04E-01	6.74E-01	7.08E-01	7.03E-01	5.27E-01	7.16E-01	6.10E-01	6.70E-01
Im 13	MEAN	1.93E+01	1.89E+01	1.59E+01	1.72E+01	1.74E+01	1.92E+01	1.88E+01	1.97E+01	1.91E+01
	MSE	3.85E+03	4.58E+03	5.62E+03	4.33E+03	3.91E+03	6.68E+03	4.10E+03	4.24E+03	7.34E+03
	STD	4.96E-01	5.62E-01	9.42E-02	9.01E-01	1.02E+00	4.76E-01	7.03E-01	8.22E-01	1.81E+00
	PSNR	1.28E+01	1.20E+01	1.07E+01	1.19E+01	1.27E+01	1.09E+01	1.23E+01	1.31E+01	1.01E+01
	SSIM	5.29E-01	4.94E-01	4.20E-01	4.86E-01	5.31E-01	4.17E-01	4.92E-01	5.03E-01	3.80E-01
	FSIM	7.32E-01	7.14E-01	7.08E-01	7.32E-01	7.30E-01	6.36E-01	7.12E-01	7.23E-01	5.68E-01
Im 14	MEAN	1.87E+01	1.99E+01	1.47E+01	1.91E+01	1.91E+01	2.05E+01	2.01E+01	2.07E+01	2.07E+01
	MSE	4.27E+03	4.56E+03	5.07E+03	4.57E+03	5.87E+03	3.74E+03	3.71E+03	4.46E+03	3.83E+03
	STD	4.01E-01	6.27E-01	5.43E-02	8.64E-01	1.20E+00	8.15E-01	9.60E-01	1.02E+00	1.95E+00
	PSNR	1.22E+01	1.19E+01	1.12E+01	1.17E+01	1.06E+01	1.27E+01	1.29E+01	1.20E+01	1.27E+01
	SSIM	5.26E-01	5.03E-01	3.88E-01	4.19E-01	4.29E-01	5.07E-01	5.43E-01	5.22E-01	5.46E-01
	FSIM	7.72E-01	7.69E-01	7.43E-01	7.75E-01	7.61E-01	7.61E-01	7.80E-01	7.82E-01	7.68E-01

Table S3: Results of AEFA variants at $th=3$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 15	MEAN	1.97E+01	2.05E+01	1.54E+01	1.91E+01	1.90E+01	2.08E+01	2.05E+01	2.12E+01	2.07E+01
	MSE	3.85E+03	4.26E+03	4.72E+03	3.54E+03	3.02E+03	4.01E+03	2.75E+03	3.66E+03	3.05E+03
	STD	2.06E-01	5.46E-01	1.75E-02	9.98E-01	8.95E-01	5.27E-01	6.07E-01	6.34E-01	1.83E+00
	PSNR	1.29E+01	1.26E+01	1.19E+01	1.30E+01	1.35E+01	1.23E+01	1.39E+01	1.32E+01	1.37E+01
	SSIM	4.93E-01	4.63E-01	4.36E-01	4.71E-01	4.89E-01	3.92E-01	4.93E-01	4.61E-01	4.61E-01
	FSIM	6.00E-01	5.84E-01	5.94E-01	6.14E-01	6.37E-01	5.56E-01	6.05E-01	5.86E-01	5.87E-01
Im 16	MEAN	2.02E+01	2.06E+01	1.61E+01	2.00E+01	1.85E+01	2.08E+01	1.99E+01	2.14E+01	2.09E+01
	MSE	3.72E+03	5.91E+03	5.88E+03	4.69E+03	4.48E+03	2.78E+03	5.25E+03	2.68E+03	4.01E+03
	STD	2.75E-01	7.20E-01	1.34E-01	1.23E+00	1.09E+00	4.53E-01	5.24E-01	7.74E-01	1.55E+00
	PSNR	1.30E+01	1.06E+01	1.12E+01	1.17E+01	1.19E+01	1.41E+01	1.18E+01	1.28E+01	1.43E+01
	SSIM	6.50E-01	6.11E-01	5.49E-01	6.09E-01	6.03E-01	6.66E-01	6.08E-01	7.04E-01	6.72E-01
	FSIM	7.94E-01	7.61E-01	7.51E-01	7.76E-01	7.83E-01	7.73E-01	7.56E-01	7.94E-01	8.00E-01
Im 17	MEAN	1.89E+01	2.07E+01	1.43E+01	1.73E+01	1.85E+01	2.07E+01	1.99E+01	2.09E+01	2.04E+01
	MSE	4.17E+03	3.29E+03	5.69E+03	4.29E+03	3.93E+03	4.75E+03	3.55E+03	4.13E+03	4.05E+03
	STD	6.16E-01	1.21E+00	4.43E-02	6.96E-01	9.79E-01	1.08E+00	1.00E+00	1.12E+00	1.89E+00
	PSNR	1.20E+01	1.31E+01	1.09E+01	1.19E+01	1.22E+01	1.37E+01	1.36E+01	1.44E+01	1.41E+01
	SSIM	5.20E-01	5.87E-01	3.78E-01	3.91E-01	4.53E-01	5.90E-01	5.56E-01	6.21E-01	5.82E-01
	FSIM	7.70E-01	7.91E-01	7.28E-01	7.75E-01	7.75E-01	7.35E-01	7.86E-01	7.58E-01	7.54E-01
Im 18	MEAN	2.04E+01	2.10E+01	1.54E+01	1.91E+01	1.91E+01	2.09E+01	2.04E+01	2.10E+01	2.11E+01
	MSE	5.34E+03	5.54E+03	5.92E+03	4.44E+03	3.50E+03	2.77E+03	4.96E+03	3.77E+03	3.94E+03
	STD	6.04E-01	8.81E-01	6.41E-02	9.56E-01	7.19E-01	6.68E-01	6.74E-01	6.59E-01	2.48E+00
	PSNR	1.14E+01	1.10E+01	1.08E+01	1.20E+01	1.31E+01	1.40E+01	1.23E+01	1.31E+01	1.28E+01
	SSIM	6.53E-01	6.57E-01	5.55E-01	6.27E-01	6.41E-01	6.39E-01	6.62E-01	6.88E-01	6.68E-01
	FSIM	7.73E-01	7.74E-01	7.46E-01	7.84E-01	7.95E-01	7.76E-01	7.73E-01	7.91E-01	7.78E-01
Im 19	MEAN	1.96E+01	2.03E+01	1.62E+01	1.81E+01	1.83E+01	2.02E+01	1.89E+01	2.10E+01	1.99E+01
	MSE	3.67E+03	4.12E+03	5.87E+03	3.99E+03	3.02E+03	2.70E+03	5.27E+03	2.62E+03	2.92E+03
	STD	5.04E-01	8.15E-01	7.30E-03	8.98E-01	1.02E+00	6.65E-01	5.61E-01	9.70E-01	1.43E+00
	PSNR	1.30E+01	1.25E+01	1.10E+01	1.31E+01	1.38E+01	1.40E+01	1.19E+01	1.41E+01	1.38E+01
	SSIM	5.68E-01	5.40E-01	4.87E-01	5.20E-01	5.30E-01	5.02E-01	4.99E-01	5.40E-01	5.41E-01
	FSIM	7.10E-01	7.02E-01	6.80E-01	7.06E-01	7.20E-01	6.74E-01	6.57E-01	7.04E-01	7.02E-01
Im 20	MEAN	1.98E+01	2.00E+01	1.62E+01	1.94E+01	1.83E+01	2.09E+01	2.05E+01	2.04E+01	2.06E+01
	MSE	3.62E+03	3.78E+03	6.47E+03	2.70E+03	3.24E+03	2.75E+03	2.58E+03	3.70E+03	3.16E+03
	STD	4.78E-01	4.34E-01	8.97E-03	9.08E-01	8.46E-01	6.78E-01	7.41E-01	7.14E-01	1.39E+00
	PSNR	1.32E+01	1.26E+01	1.10E+01	1.40E+01	1.35E+01	1.41E+01	1.43E+01	1.29E+01	1.34E+01
	SSIM	5.40E-01	5.35E-01	4.40E-01	5.43E-01	5.30E-01	5.16E-01	5.36E-01	4.99E-01	4.98E-01
	FSIM	7.08E-01	6.95E-01	6.68E-01	7.20E-01	7.08E-01	6.86E-01	7.04E-01	6.85E-01	6.86E-01
Im 21	MEAN	1.99E+01	2.01E+01	1.61E+01	1.91E+01	1.92E+01	2.05E+01	1.98E+01	2.09E+01	2.05E+01
	MSE	2.82E+03	3.55E+03	4.12E+03	2.50E+03	2.66E+03	3.68E+03	4.02E+03	3.58E+03	3.50E+03
	STD	3.77E-01	2.73E-01	1.19E-01	7.68E-01	1.14E+00	5.11E-01	4.53E-01	7.76E-01	1.29E+00
	PSNR	1.39E+01	1.31E+01	1.21E+01	1.44E+01	1.40E+01	1.29E+01	1.24E+01	1.29E+01	1.31E+01
	SSIM	5.74E-01	5.37E-01	4.63E-01	5.56E-01	5.53E-01	4.93E-01	5.17E-01	5.20E-01	5.24E-01
	FSIM	7.10E-01	6.99E-01	6.79E-01	7.13E-01	6.89E-01	6.72E-01	6.75E-01	7.17E-01	6.79E-01

Table S4: Results of AEFA variants at $th=3$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 22	MEAN	1.95E+01	1.98E+01	1.54E+01	1.91E+01	1.78E+01	1.99E+01	2.01E+01	2.05E+01	2.10E+01
	MSE	3.47E+03	3.00E+03	3.98E+03	2.87E+03	3.00E+03	4.40E+03	2.91E+03	3.56E+03	2.77E+03
	STD	2.66E-01	6.83E-01	1.66E-02	1.19E+00	8.30E-01	3.30E-01	6.50E-01	5.12E-01	1.13E+00
	PSNR	1.34E+01	1.40E+01	1.24E+01	1.39E+01	1.37E+01	1.18E+01	1.38E+01	1.42E+01	1.31E+01
	SSIM	5.65E-01	5.70E-01	5.18E-01	5.52E-01	5.47E-01	4.71E-01	5.37E-01	5.44E-01	5.48E-01
	FSIM	7.15E-01	7.21E-01	6.99E-01	7.28E-01	6.99E-01	6.32E-01	6.99E-01	7.30E-01	7.13E-01
Im 23	MEAN	1.93E+01	2.00E+01	1.68E+01	1.89E+01	1.82E+01	2.10E+01	2.00E+01	2.08E+01	2.05E+01
	MSE	3.31E+03	2.77E+03	3.82E+03	2.84E+03	2.73E+03	2.71E+03	2.96E+03	2.58E+03	3.30E+03
	STD	4.06E-01	6.64E-01	4.97E-02	7.50E-01	9.15E-01	6.53E-01	7.55E-01	9.69E-01	1.06E+00
	PSNR	1.35E+01	1.41E+01	1.27E+01	1.42E+01	1.43E+01	1.43E+01	1.37E+01	1.44E+01	1.35E+01
	SSIM	5.76E-01	5.96E-01	5.01E-01	5.72E-01	5.75E-01	5.64E-01	5.57E-01	5.71E-01	5.29E-01
	FSIM	7.04E-01	7.16E-01	6.86E-01	7.18E-01	6.89E-01	6.95E-01	6.87E-01	7.28E-01	6.76E-01
Im 24	MEAN	2.10E+01	2.18E+01	1.64E+01	1.99E+01	1.94E+01	2.15E+01	2.06E+01	2.14E+01	2.08E+01
	MSE	4.04E+03	3.29E+03	5.70E+03	3.50E+03	2.60E+03	3.49E+03	3.38E+03	3.38E+03	3.19E+03
	STD	4.31E-01	7.46E-01	1.34E-01	1.15E+00	1.04E+00	4.48E-01	4.42E-01	5.06E-01	8.97E-01
	PSNR	1.27E+01	1.32E+01	1.13E+01	1.28E+01	1.41E+01	1.30E+01	1.33E+01	1.31E+01	1.34E+01
	SSIM	4.93E-01	4.99E-01	4.17E-01	4.64E-01	5.19E-01	4.18E-01	4.66E-01	4.52E-01	4.58E-01
	FSIM	6.65E-01	6.75E-01	6.05E-01	6.36E-01	6.27E-01	6.15E-01	6.33E-01	6.94E-01	6.35E-01
Im 25	MEAN	1.91E+01	1.95E+01	1.59E+01	1.75E+01	1.85E+01	2.00E+01	1.91E+01	2.08E+01	2.05E+01
	MSE	4.34E+03	3.98E+03	7.19E+03	3.34E+03	2.63E+03	3.42E+03	4.59E+03	2.48E+03	2.24E+03
	STD	5.54E-01	6.33E-01	2.22E-02	8.74E-01	9.68E-01	6.92E-01	6.09E-01	1.24E+00	1.52E+00
	PSNR	1.26E+01	1.28E+01	1.08E+01	1.33E+01	1.43E+01	1.34E+01	1.26E+01	1.44E+01	1.47E+01
	SSIM	5.64E-01	5.69E-01	4.57E-01	5.53E-01	5.66E-01	5.07E-01	5.34E-01	5.64E-01	5.78E-01
	FSIM	7.16E-01	7.21E-01	6.89E-01	7.25E-01	7.23E-01	6.68E-01	6.94E-01	7.30E-01	7.03E-01
Im 26	MEAN	1.95E+01	2.01E+01	1.57E+01	1.85E+01	1.93E+01	2.03E+01	2.00E+01	2.07E+01	2.06E+01
	MSE	4.00E+03	3.68E+03	6.92E+03	3.31E+03	2.55E+03	2.97E+03	3.17E+03	2.27E+03	2.42E+03
	STD	4.44E-01	6.73E-01	6.31E-02	1.14E+00	9.07E-01	4.66E-01	5.46E-01	8.84E-01	1.44E+00
	PSNR	1.27E+01	1.29E+01	1.15E+01	1.34E+01	1.42E+01	1.38E+01	1.36E+01	1.49E+01	1.46E+01
	SSIM	5.99E-01	5.86E-01	4.68E-01	5.77E-01	5.87E-01	5.59E-01	5.82E-01	6.14E-01	5.87E-01
	FSIM	7.18E-01	7.23E-01	6.91E-01	7.37E-01	7.12E-01	6.75E-01	6.99E-01	7.45E-01	7.07E-01
Im 27	MEAN	1.96E+01	2.01E+01	1.60E+01	1.87E+01	1.90E+01	2.01E+01	1.98E+01	2.12E+01	2.01E+01
	MSE	3.57E+03	3.09E+03	3.85E+03	2.14E+03	2.29E+03	3.62E+03	3.76E+03	2.45E+03	3.28E+03
	STD	6.09E-01	6.18E-01	3.71E-02	1.18E+00	9.95E-01	5.15E-01	6.66E-01	9.28E-01	1.16E+00
	PSNR	1.31E+01	1.39E+01	1.28E+01	1.50E+01	1.49E+01	1.29E+01	1.26E+01	1.47E+01	1.34E+01
	SSIM	5.54E-01	5.72E-01	5.24E-01	5.93E-01	5.81E-01	5.19E-01	5.41E-01	5.91E-01	5.37E-01
	FSIM	6.82E-01	7.01E-01	6.80E-01	7.12E-01	7.05E-01	6.41E-01	6.65E-01	7.03E-01	6.57E-01
Im 28	MEAN	1.92E+01	1.97E+01	1.59E+01	1.87E+01	1.87E+01	2.05E+01	1.94E+01	2.10E+01	2.06E+01
	MSE	3.88E+03	4.63E+03	3.86E+03	3.08E+03	3.45E+03	3.31E+03	3.17E+03	2.60E+03	2.64E+03
	STD	3.98E-01	6.03E-01	4.66E-02	7.75E-01	1.11E+00	5.98E-01	8.06E-01	7.38E-01	1.01E+00
	PSNR	1.27E+01	1.21E+01	1.25E+01	1.36E+01	1.30E+01	1.33E+01	1.35E+01	1.43E+01	1.43E+01
	SSIM	5.95E-01	5.66E-01	5.45E-01	5.86E-01	5.69E-01	5.46E-01	5.56E-01	5.75E-01	5.91E-01
	FSIM	7.09E-01	7.07E-01	7.02E-01	7.17E-01	7.16E-01	6.82E-01	6.81E-01	7.10E-01	7.04E-01

Table S5: Results of AEFA variants at $th=3$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 29	MEAN	1.84E+01	1.97E+01	1.52E+01	1.78E+01	1.80E+01	2.00E+01	1.98E+01	2.01E+01	2.01E+01
	MSE	2.94E+03	2.75E+03	3.98E+03	2.39E+03	2.94E+03	3.53E+03	3.77E+03	3.15E+03	3.59E+03
	STD	1.70E-01	6.50E-01	6.36E-02	9.33E-01	1.04E+00	5.15E-01	7.18E-01	6.36E-01	1.71E+00
	PSNR	1.39E+01	1.42E+01	1.22E+01	1.48E+01	1.37E+01	1.29E+01	1.29E+01	1.34E+01	1.28E+01
	SSIM	5.95E-01	6.13E-01	5.42E-01	6.20E-01	5.91E-01	5.39E-01	5.80E-01	5.74E-01	5.36E-01
	FSIM	7.01E-01	7.16E-01	6.79E-01	6.95E-01	7.07E-01	6.72E-01	6.94E-01	7.21E-01	6.74E-01
Im 30	MEAN	1.89E+01	2.01E+01	1.50E+01	1.82E+01	1.80E+01	2.01E+01	1.99E+01	1.96E+01	2.01E+01
	MSE	4.52E+03	3.42E+03	5.73E+03	4.90E+03	4.44E+03	4.87E+03	3.73E+03	2.83E+03	4.71E+03
	STD	3.37E-01	9.17E-01	7.09E-02	8.23E-01	1.16E+00	7.44E-01	7.37E-01	7.31E-01	1.36E+00
	PSNR	1.22E+01	1.29E+01	1.10E+01	1.16E+01	1.30E+01	1.16E+01	1.28E+01	1.38E+01	1.18E+01
	SSIM	5.05E-01	4.89E-01	4.02E-01	5.09E-01	4.35E-01	4.21E-01	4.58E-01	4.45E-01	4.25E-01
	FSIM	7.12E-01	7.52E-01	6.72E-01	7.25E-01	7.35E-01	7.37E-01	7.33E-01	7.53E-01	7.41E-01

Table S6: Results of AEFA variants at $th=6$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 1	MEAN	3.06E+01	3.28E+01	2.22E+01	2.93E+01	3.02E+01	3.16E+01	3.08E+01	3.09E+01	3.12E+01
	MSE	2.23E+03	1.14E+03	5.67E+03	2.03E+03	2.60E+03	6.91E+03	2.63E+03	3.77E+03	3.49E+03
	STD	9.72E-01	1.42E+00	6.87E-02	1.55E+00	1.52E+00	1.10E+00	1.17E+00	1.50E+00	1.85E+00
	PSNR	1.54E+01	1.79E+01	1.08E+01	1.55E+01	1.48E+01	1.12E+01	1.48E+01	1.25E+01	1.38E+01
	SSIM	6.09E-01	6.68E-01	4.39E-01	5.89E-01	5.44E-01	3.93E-01	5.72E-01	4.78E-01	5.03E-01
	FSIM	7.26E-01	6.70E-01	6.20E-01	6.92E-01	7.08E-01	6.02E-01	6.71E-01	6.30E-01	6.57E-01
Im 2	MEAN	2.89E+01	3.13E+01	2.17E+01	2.88E+01	3.04E+01	3.10E+01	3.03E+01	3.13E+01	3.07E+01
	MSE	1.50E+03	1.27E+03	3.39E+03	1.52E+03	1.37E+03	2.76E+03	2.32E+03	2.44E+03	2.27E+03
	STD	7.81E-01	1.73E+00	1.83E-01	1.65E+00	2.06E+00	1.02E+00	1.31E+00	1.29E+00	2.08E+00
	PSNR	1.72E+01	1.77E+01	1.31E+01	1.75E+01	1.70E+01	1.45E+01	1.51E+01	1.53E+01	1.54E+01
	SSIM	6.82E-01	6.78E-01	5.61E-01	6.73E-01	6.55E-01	5.65E-01	6.12E-01	6.00E-01	5.99E-01
	FSIM	7.57E-01	7.62E-01	6.74E-01	7.53E-01	7.40E-01	6.66E-01	7.16E-01	6.94E-01	6.82E-01
Im 3	MEAN	2.89E+01	3.23E+01	2.29E+01	2.96E+01	2.93E+01	3.11E+01	3.04E+01	3.21E+01	3.14E+01
	MSE	1.32E+03	1.10E+03	3.68E+03	1.28E+03	1.34E+03	1.73E+03	2.16E+03	1.24E+03	1.38E+03
	STD	6.10E-01	1.28E+00	1.73E-02	1.57E+00	1.60E+00	1.18E+00	1.57E+00	1.27E+00	1.69E+00
	PSNR	1.76E+01	1.81E+01	1.27E+01	1.77E+01	1.72E+01	1.62E+01	1.54E+01	1.80E+01	1.74E+01
	SSIM	6.88E-01	6.93E-01	5.66E-01	6.69E-01	6.51E-01	6.11E-01	6.08E-01	6.72E-01	6.54E-01
	FSIM	7.86E-01	7.93E-01	7.16E-01	7.91E-01	7.69E-01	7.35E-01	7.32E-01	7.84E-01	7.68E-01
Im 4	MEAN	3.16E+01	3.30E+01	2.25E+01	2.97E+01	2.92E+01	3.26E+01	3.07E+01	3.23E+01	3.26E+01
	MSE	2.14E+03	1.69E+03	4.14E+03	2.11E+03	2.30E+03	2.01E+03	1.24E+03	1.55E+03	1.57E+03
	STD	8.02E-01	1.07E+00	2.79E-02	1.62E+00	1.46E+00	1.05E+00	1.24E+00	1.42E+00	1.84E+00
	PSNR	1.56E+01	1.61E+01	1.22E+01	1.54E+01	1.48E+01	1.54E+01	1.78E+01	1.66E+01	1.65E+01
	SSIM	6.03E-01	6.26E-01	4.63E-01	5.95E-01	5.57E-01	5.08E-01	6.77E-01	5.78E-01	5.78E-01
	FSIM	7.26E-01	7.31E-01	6.45E-01	7.28E-01	7.14E-01	6.92E-01	7.60E-01	7.22E-01	7.27E-01

Table S7: Results of AEFA variants at $th=6$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 5	MEAN	3.02E+01	3.31E+01	2.37E+01	2.96E+01	2.93E+01	3.37E+01	3.33E+01	3.37E+01	3.38E+01
	MSE	9.72E+02	9.71E+02	2.73E+03	9.71E+02	1.46E+03	4.89E+03	3.85E+03	5.57E+03	4.68E+03
	STD	3.90E-01	1.04E+00	1.59E-01	1.50E+00	1.23E+00	1.18E+00	1.45E+00	1.25E+00	1.62E+00
	PSNR	1.87E+01	1.91E+01	1.57E+01	1.85E+01	1.73E+01	1.35E+01	1.43E+01	1.23E+01	1.29E+01
	SSIM	7.62E-01	7.31E-01	5.86E-01	7.34E-01	6.59E-01	4.66E-01	5.49E-01	3.88E-01	4.66E-01
	FSIM	8.63E-01	8.63E-01	7.44E-01	8.70E-01	8.31E-01	7.17E-01	7.38E-01	6.58E-01	6.91E-01
Im 6	MEAN	3.05E+01	3.30E+01	2.30E+01	2.97E+01	2.99E+01	3.28E+01	3.12E+01	3.27E+01	3.22E+01
	MSE	9.79E+02	1.37E+03	6.77E+03	2.24E+03	7.46E+02	6.38E+03	1.80E+03	4.73E+03	1.82E+03
	STD	9.93E-01	1.47E+00	3.99E-03	1.49E+00	1.70E+00	1.11E+00	1.13E+00	1.44E+00	1.54E+00
	PSNR	1.83E+01	1.78E+01	1.43E+01	1.82E+01	1.96E+01	1.38E+01	1.64E+01	1.54E+01	1.66E+01
	SSIM	7.15E-01	6.93E-01	4.89E-01	6.73E-01	7.34E-01	4.74E-01	6.67E-01	5.45E-01	6.43E-01
	FSIM	8.16E-01	8.00E-01	7.24E-01	7.93E-01	8.23E-01	7.09E-01	7.78E-01	7.38E-01	7.57E-01
Im 7	MEAN	3.16E+01	3.40E+01	2.41E+01	2.98E+01	2.89E+01	3.26E+01	3.29E+01	3.37E+01	3.40E+01
	MSE	1.21E+03	1.12E+03	3.91E+03	1.12E+03	1.14E+03	7.91E+03	3.25E+03	4.32E+03	4.96E+03
	STD	9.94E-01	1.05E+00	7.74E-02	1.38E+00	1.51E+00	1.12E+00	1.56E+00	1.49E+00	1.55E+00
	PSNR	1.81E+01	1.76E+01	1.43E+01	1.81E+01	1.81E+01	1.10E+01	1.45E+01	1.47E+01	1.32E+01
	SSIM	7.14E-01	7.43E-01	5.17E-01	7.29E-01	7.15E-01	3.08E-01	5.94E-01	5.25E-01	4.65E-01
	FSIM	8.61E-01	8.46E-01	7.26E-01	8.60E-01	8.63E-01	6.17E-01	7.73E-01	7.52E-01	7.09E-01
Im 8	MEAN	2.97E+01	3.16E+01	2.23E+01	2.87E+01	2.95E+01	3.08E+01	3.04E+01	3.09E+01	3.14E+01
	MSE	1.26E+03	1.42E+03	2.04E+03	1.31E+03	1.01E+03	3.09E+03	2.26E+03	2.43E+03	1.70E+03
	STD	9.00E-01	1.43E+00	1.55E-02	1.66E+00	1.65E+00	9.74E-01	1.09E+00	1.21E+00	2.41E+00
	PSNR	1.77E+01	1.74E+01	1.55E+01	1.74E+01	1.85E+01	1.39E+01	1.53E+01	1.46E+01	1.65E+01
	SSIM	6.65E-01	6.40E-01	6.23E-01	6.66E-01	6.83E-01	5.58E-01	6.00E-01	5.89E-01	6.36E-01
	FSIM	7.66E-01	7.44E-01	7.14E-01	7.42E-01	7.65E-01	6.55E-01	7.14E-01	6.74E-01	7.20E-01
Im 9	MEAN	2.89E+01	3.09E+01	2.42E+01	2.86E+01	2.73E+01	3.11E+01	2.98E+01	3.20E+01	3.06E+01
	MSE	1.55E+03	9.97E+02	3.71E+03	1.91E+03	2.54E+03	2.56E+03	2.12E+03	2.49E+03	3.68E+03
	STD	7.40E-01	1.39E+00	1.06E-01	1.76E+00	1.45E+00	1.33E+00	1.30E+00	1.62E+00	2.11E+00
	PSNR	1.71E+01	1.86E+01	1.26E+01	1.64E+01	1.46E+01	1.46E+01	1.55E+01	1.47E+01	1.46E+01
	SSIM	6.73E-01	7.00E-01	5.61E-01	6.20E-01	5.87E-01	5.70E-01	6.17E-01	6.09E-01	5.70E-01
	FSIM	7.51E-01	7.76E-01	7.03E-01	7.41E-01	7.24E-01	6.96E-01	7.19E-01	7.09E-01	6.87E-01
Im 10	MEAN	2.86E+01	3.11E+01	2.21E+01	2.80E+01	2.93E+01	3.15E+01	2.99E+01	3.22E+01	3.10E+01
	MSE	1.19E+03	1.14E+03	3.70E+03	1.89E+03	1.35E+03	2.38E+03	2.21E+03	1.56E+03	1.73E+03
	STD	1.03E+00	1.07E+00	5.09E-02	1.32E+00	1.51E+00	1.03E+00	1.43E+00	1.61E+00	2.07E+00
	PSNR	1.79E+01	1.77E+01	1.25E+01	1.60E+01	1.79E+01	1.51E+01	1.53E+01	1.68E+01	1.65E+01
	SSIM	7.02E-01	6.90E-01	5.61E-01	6.36E-01	6.85E-01	5.45E-01	6.22E-01	6.48E-01	6.35E-01
	FSIM	7.89E-01	7.91E-01	7.26E-01	7.61E-01	7.94E-01	6.86E-01	7.42E-01	7.68E-01	7.68E-01

Table S8: *Results of AEFA variants at th=6.*

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 12	MEAN	3.03E+01	3.12E+01	2.28E+01	2.99E+01	2.81E+01	3.24E+01	2.99E+01	3.30E+01	3.24E+01
	MSE	1.55E+03	2.19E+03	4.35E+03	2.43E+03	2.61E+03	2.17E+03	1.66E+03	1.82E+03	1.46E+03
	STD	9.91E-01	9.91E-01	6.50E-02	1.67E+00	1.29E+00	1.37E+00	5.63E-01	1.61E+00	1.65E+00
	PSNR	1.70E+01	1.51E+01	1.20E+01	1.45E+01	1.44E+01	1.53E+01	1.63E+01	1.61E+01	1.71E+01
	SSIM	7.30E-01	6.51E-01	4.64E-01	6.13E-01	5.44E-01	5.72E-01	6.71E-01	6.22E-01	6.91E-01
	FSIM	8.42E-01	8.43E-01	7.65E-01	8.26E-01	8.26E-01	8.03E-01	8.37E-01	8.30E-01	8.38E-01
Im 13	MEAN	3.12E+01	3.38E+01	2.44E+01	2.98E+01	3.00E+01	3.24E+01	3.18E+01	3.26E+01	3.31E+01
	MSE	1.53E+03	1.49E+03	3.23E+03	1.92E+03	1.70E+03	3.39E+03	1.58E+03	2.05E+03	2.01E+03
	STD	3.59E-01	1.13E+00	2.57E-01	1.65E+00	1.69E+00	1.01E+00	9.35E-01	1.13E+00	1.88E+00
	PSNR	1.65E+01	1.68E+01	1.33E+01	1.62E+01	1.61E+01	1.34E+01	1.64E+01	1.55E+01	1.54E+01
	SSIM	6.07E-01	6.17E-01	5.28E-01	5.97E-01	5.77E-01	4.26E-01	5.95E-01	5.29E-01	5.28E-01
	FSIM	7.14E-01	7.21E-01	6.47E-01	7.06E-01	7.11E-01	5.97E-01	6.97E-01	6.57E-01	6.66E-01
Im 14	MEAN	3.09E+01	3.35E+01	2.14E+01	2.94E+01	3.09E+01	3.27E+01	3.13E+01	3.34E+01	3.34E+01
	MSE	2.30E+03	1.84E+03	3.68E+03	1.68E+03	1.98E+03	1.49E+03	1.72E+03	1.08E+03	1.07E+03
	STD	5.66E-01	1.12E+00	6.00E-02	1.49E+00	1.78E+00	1.26E+00	9.23E-01	1.36E+00	2.05E+00
	PSNR	1.54E+01	1.63E+01	1.25E+01	1.62E+01	1.55E+01	1.67E+01	1.66E+01	1.82E+01	1.81E+01
	SSIM	7.55E-01	7.58E-01	5.84E-01	7.27E-01	6.81E-01	6.77E-01	7.37E-01	7.77E-01	7.48E-01
	FSIM	8.35E-01	8.36E-01	7.72E-01	8.34E-01	8.15E-01	8.06E-01	8.13E-01	8.42E-01	8.41E-01
Im 15	MEAN	3.14E+01	3.32E+01	2.52E+01	3.13E+01	3.09E+01	3.30E+01	3.14E+01	3.31E+01	3.26E+01
	MSE	1.63E+03	1.44E+03	3.61E+03	1.46E+03	1.67E+03	1.53E+03	1.83E+03	1.30E+03	1.06E+03
	STD	6.47E-01	1.19E+00	3.31E-02	1.98E+00	1.68E+00	1.32E+00	1.32E+00	1.08E+00	2.04E+00
	PSNR	1.68E+01	1.71E+01	1.28E+01	1.69E+01	1.65E+01	1.66E+01	1.69E+01	1.74E+01	1.85E+01
	SSIM	7.81E-01	7.97E-01	6.14E-01	7.38E-01	7.56E-01	6.97E-01	7.77E-01	7.68E-01	8.00E-01
	FSIM	8.51E-01	8.42E-01	7.96E-01	8.45E-01	8.46E-01	8.20E-01	8.42E-01	8.40E-01	8.60E-01
Im 16	MEAN	2.89E+01	3.23E+01	2.18E+01	2.81E+01	2.87E+01	3.09E+01	3.06E+01	3.12E+01	3.12E+01
	MSE	2.71E+03	1.59E+03	3.98E+03	2.68E+03	3.28E+03	4.44E+03	2.16E+03	1.47E+03	1.57E+03
	STD	6.00E-01	1.04E+00	1.12E-01	1.37E+00	1.62E+00	1.33E+00	1.49E+00	1.40E+00	2.00E+00
	PSNR	1.39E+01	1.69E+01	1.22E+01	1.41E+01	1.31E+01	1.46E+01	1.58E+01	1.68E+01	1.69E+01
	SSIM	5.20E-01	7.12E-01	4.63E-01	5.24E-01	4.61E-01	6.20E-01	6.62E-01	7.25E-01	7.11E-01
	FSIM	7.94E-01	8.30E-01	7.70E-01	8.26E-01	7.92E-01	7.53E-01	7.99E-01	8.08E-01	8.23E-01
Im 17	MEAN	3.12E+01	3.20E+01	2.54E+01	3.11E+01	2.97E+01	3.31E+01	3.09E+01	3.37E+01	3.30E+01
	MSE	1.76E+03	1.31E+03	3.90E+03	1.23E+03	1.49E+03	1.67E+03	1.36E+03	1.15E+03	1.03E+03
	STD	8.45E-01	1.09E+00	4.96E-02	1.94E+00	1.48E+00	1.11E+00	8.91E-01	1.52E+00	2.77E+00
	PSNR	1.65E+01	1.78E+01	1.28E+01	1.76E+01	1.69E+01	1.64E+01	1.76E+01	1.77E+01	1.81E+01
	SSIM	7.56E-01	7.79E-01	6.66E-01	7.69E-01	7.55E-01	7.00E-01	7.91E-01	7.85E-01	7.84E-01
	FSIM	8.42E-01	8.51E-01	7.94E-01	8.50E-01	8.39E-01	8.14E-01	8.46E-01	8.41E-01	8.47E-01
Im 18	MEAN	3.19E+01	3.28E+01	2.40E+01	3.02E+01	3.15E+01	3.28E+01	3.13E+01	3.39E+01	3.34E+01
	MSE	1.70E+03	1.97E+03	4.22E+03	1.63E+03	1.13E+03	1.65E+03	1.37E+03	1.31E+03	1.01E+03
	STD	7.82E-01	9.79E-01	5.92E-02	1.76E+00	1.80E+00	1.16E+00	8.02E-01	1.77E+00	1.99E+00
	PSNR	1.64E+01	1.59E+01	1.22E+01	1.63E+01	1.78E+01	1.63E+01	1.74E+01	1.73E+01	1.82E+01
	SSIM	7.67E-01	7.68E-01	6.44E-01	7.55E-01	8.01E-01	6.94E-01	7.92E-01	7.60E-01	7.68E-01
	FSIM	8.32E-01	8.31E-01	7.71E-01	8.34E-01	8.52E-01	8.11E-01	8.40E-01	8.23E-01	8.41E-01

Table S9: Results of AEFA variants at $th=6$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 19	MEAN	3.09E+01	3.09E+01	2.31E+01	2.95E+01	2.94E+01	3.22E+01	3.08E+01	3.20E+01	3.20E+01
	MSE	1.33E+03	1.39E+03	3.04E+03	1.91E+03	1.67E+03	2.46E+03	2.42E+03	1.91E+03	1.57E+03
	STD	5.82E-01	9.47E-01	4.03E-02	1.66E+00	1.58E+00	9.55E-01	1.13E+00	1.38E+00	2.82E+00
	PSNR	1.72E+01	1.72E+01	1.35E+01	1.53E+01	1.61E+01	1.44E+01	1.48E+01	1.55E+01	1.65E+01
	SSIM	6.57E-01	6.62E-01	5.69E-01	5.83E-01	6.21E-01	5.15E-01	5.88E-01	5.90E-01	6.19E-01
	FSIM	7.65E-01	7.66E-01	7.24E-01	7.35E-01	7.49E-01	6.63E-01	7.24E-01	7.06E-01	7.33E-01
Im 20	MEAN	3.13E+01	3.21E+01	2.32E+01	3.02E+01	2.90E+01	3.27E+01	3.12E+01	3.27E+01	3.29E+01
	MSE	1.91E+03	1.30E+03	3.51E+03	1.35E+03	1.05E+03	3.22E+03	1.70E+03	2.13E+03	1.78E+03
	STD	1.06E+00	1.00E+00	4.14E-02	1.53E+00	1.54E+00	8.45E-01	1.28E+00	1.25E+00	2.26E+00
	PSNR	1.64E+01	1.75E+01	1.31E+01	1.70E+01	1.81E+01	1.32E+01	1.65E+01	1.55E+01	1.61E+01
	SSIM	6.77E-01	6.90E-01	5.92E-01	6.66E-01	6.88E-01	4.73E-01	6.11E-01	5.90E-01	6.01E-01
	FSIM	7.56E-01	7.69E-01	7.30E-01	7.62E-01	7.79E-01	6.58E-01	7.41E-01	7.21E-01	7.31E-01
Im 21	MEAN	3.12E+01	3.24E+01	2.28E+01	3.13E+01	3.02E+01	3.35E+01	3.10E+01	3.34E+01	3.29E+01
	MSE	1.50E+03	1.22E+03	2.98E+03	1.67E+03	1.29E+03	3.15E+03	1.97E+03	2.25E+03	2.01E+03
	STD	1.05E+00	1.06E+00	3.47E-02	1.84E+00	1.69E+00	1.13E+00	7.64E-01	1.27E+00	2.65E+00
	PSNR	1.67E+01	1.75E+01	1.35E+01	1.63E+01	1.73E+01	1.35E+01	1.59E+01	1.50E+01	1.56E+01
	SSIM	6.64E-01	6.89E-01	5.50E-01	6.54E-01	6.54E-01	5.16E-01	6.43E-01	5.56E-01	5.87E-01
	FSIM	7.60E-01	7.70E-01	7.19E-01	7.57E-01	7.63E-01	6.97E-01	7.53E-01	7.21E-01	7.31E-01
Im 22	MEAN	3.03E+01	3.23E+01	2.33E+01	2.92E+01	3.04E+01	3.21E+01	3.18E+01	3.24E+01	3.27E+01
	MSE	1.49E+03	1.11E+03	2.91E+03	1.70E+03	1.43E+03	3.19E+03	1.44E+03	2.16E+03	2.06E+03
	STD	6.23E-01	1.28E+00	3.65E-02	1.68E+00	1.77E+00	1.09E+00	1.30E+00	1.24E+00	2.28E+00
	PSNR	1.70E+01	1.79E+01	1.44E+01	1.67E+01	1.69E+01	1.37E+01	1.71E+01	1.54E+01	1.57E+01
	SSIM	6.64E-01	6.83E-01	6.01E-01	6.59E-01	6.67E-01	5.30E-01	6.54E-01	6.21E-01	6.07E-01
	FSIM	7.71E-01	7.74E-01	7.39E-01	7.70E-01	7.72E-01	6.71E-01	7.75E-01	7.15E-01	7.25E-01
Im 23	MEAN	3.11E+01	3.27E+01	2.32E+01	3.07E+01	3.03E+01	3.14E+01	3.07E+01	3.23E+01	3.19E+01
	MSE	1.36E+03	1.04E+03	2.97E+03	1.16E+03	1.26E+03	2.23E+03	4.63E+03	2.76E+03	1.61E+03
	STD	8.65E-01	8.01E-01	4.18E-01	1.81E+00	1.58E+00	1.04E+00	9.94E-01	1.16E+00	1.45E+00
	PSNR	1.82E+01	1.75E+01	1.42E+01	1.79E+01	1.74E+01	1.52E+01	1.42E+01	1.42E+01	1.68E+01
	SSIM	7.01E-01	6.80E-01	5.80E-01	6.80E-01	6.70E-01	5.86E-01	5.75E-01	5.65E-01	6.42E-01
	FSIM	7.74E-01	7.72E-01	7.28E-01	7.75E-01	7.68E-01	6.88E-01	7.17E-01	6.68E-01	7.31E-01
Im 24	MEAN	3.18E+01	3.45E+01	2.41E+01	3.11E+01	3.21E+01	3.37E+01	3.25E+01	3.40E+01	3.35E+01
	MSE	1.11E+03	1.29E+03	3.80E+03	1.20E+03	1.25E+03	2.53E+03	2.02E+03	2.83E+03	1.93E+03
	STD	5.67E-01	1.60E+00	6.20E-03	1.74E+00	1.75E+00	1.09E+00	1.06E+00	1.04E+00	2.19E+00
	PSNR	1.74E+01	1.80E+01	1.28E+01	1.75E+01	1.73E+01	1.45E+01	1.56E+01	1.42E+01	1.57E+01
	SSIM	6.58E-01	6.90E-01	4.84E-01	6.36E-01	6.37E-01	4.74E-01	5.99E-01	4.70E-01	5.73E-01
	FSIM	8.06E-01	7.97E-01	6.40E-01	7.79E-01	7.90E-01	6.72E-01	7.39E-01	6.59E-01	7.27E-01
Im 25	MEAN	3.07E+01	3.10E+01	2.35E+01	2.96E+01	3.04E+01	3.23E+01	2.98E+01	3.37E+01	3.14E+01
	MSE	1.62E+03	1.44E+03	2.75E+03	1.67E+03	1.52E+03	1.96E+03	2.87E+03	1.70E+03	1.55E+03
	STD	8.92E-01	1.11E+00	2.14E-01	1.45E+00	1.97E+00	1.13E+00	1.21E+00	1.89E+00	1.80E+00
	PSNR	1.68E+01	1.65E+01	1.43E+01	1.60E+01	1.65E+01	1.54E+01	1.49E+01	1.61E+01	1.65E+01
	SSIM	6.62E-01	6.58E-01	6.10E-01	6.45E-01	6.45E-01	5.97E-01	6.33E-01	6.22E-01	6.30E-01
	FSIM	7.66E-01	7.56E-01	7.51E-01	7.49E-01	7.59E-01	7.03E-01	7.56E-01	7.45E-01	7.52E-01

Table S10: Results of AEFA variants at $th=6$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 26	MEAN	2.96E+01	3.15E+01	2.20E+01	3.00E+01	2.99E+01	3.16E+01	3.11E+01	3.23E+01	3.21E+01
	MSE	1.39E+03	1.40E+03	2.64E+03	1.25E+03	1.34E+03	2.67E+03	2.04E+03	1.87E+03	1.99E+03
	STD	9.06E-01	1.04E+00	1.04E-02	1.61E+00	1.72E+00	1.09E+00	1.09E+00	1.11E+00	1.93E+00
	PSNR	1.72E+01	1.77E+01	1.42E+01	1.74E+01	1.70E+01	1.45E+01	1.53E+01	1.57E+01	1.59E+01
	SSIM	7.11E-01	7.13E-01	6.26E-01	6.74E-01	6.54E-01	5.84E-01	6.53E-01	6.35E-01	6.49E-01
	FSIM	7.72E-01	7.75E-01	7.49E-01	7.72E-01	7.66E-01	6.77E-01	7.39E-01	7.17E-01	7.31E-01
Im 27	MEAN	3.04E+01	3.24E+01	2.43E+01	2.92E+01	2.96E+01	3.27E+01	3.05E+01	3.31E+01	3.14E+01
	MSE	1.55E+03	1.48E+03	2.74E+03	1.61E+03	1.23E+03	2.25E+03	1.44E+03	1.64E+03	2.46E+03
	STD	1.03E+00	1.26E+00	1.44E-01	1.33E+00	1.39E+00	1.14E+00	9.74E-01	1.52E+00	2.18E+00
	PSNR	1.70E+01	1.70E+01	1.41E+01	1.64E+01	1.75E+01	1.49E+01	1.70E+01	1.63E+01	1.49E+01
	SSIM	6.83E-01	6.77E-01	6.11E-01	6.39E-01	6.69E-01	6.03E-01	6.78E-01	6.38E-01	5.98E-01
	FSIM	7.49E-01	7.58E-01	7.25E-01	7.39E-01	7.60E-01	6.78E-01	7.48E-01	7.10E-01	6.81E-01
Im 28	MEAN	3.07E+01	3.31E+01	2.36E+01	2.98E+01	2.90E+01	3.18E+01	3.07E+01	3.35E+01	3.22E+01
	MSE	1.12E+03	1.27E+03	3.71E+03	1.37E+03	1.20E+03	5.51E+03	1.97E+03	1.62E+03	2.28E+03
	STD	8.58E-01	1.15E+00	8.97E-02	1.42E+00	1.15E+00	8.60E-01	8.86E-01	1.46E+00	9.63E-01
	PSNR	1.80E+01	1.74E+01	1.28E+01	1.72E+01	1.74E+01	1.29E+01	1.61E+01	1.65E+01	1.52E+01
	SSIM	7.00E-01	7.26E-01	6.08E-01	6.85E-01	6.78E-01	5.19E-01	6.65E-01	6.73E-01	6.16E-01
	FSIM	7.90E-01	7.71E-01	7.29E-01	7.77E-01	7.69E-01	6.47E-01	7.49E-01	7.41E-01	7.18E-01
Im 29	MEAN	3.00E+01	3.09E+01	2.47E+01	2.96E+01	2.91E+01	3.09E+01	3.13E+01	3.24E+01	3.26E+01
	MSE	1.53E+03	9.42E+02	2.09E+03	1.02E+03	1.21E+03	3.05E+03	2.06E+03	2.69E+03	2.69E+03
	STD	6.95E-01	1.02E+00	2.73E-01	1.61E+00	1.56E+00	1.03E+00	1.37E+00	1.52E+00	2.53E+00
	PSNR	1.68E+01	1.87E+01	1.53E+01	1.82E+01	1.76E+01	1.35E+01	1.55E+01	1.41E+01	1.42E+01
	SSIM	6.92E-01	7.32E-01	6.60E-01	7.19E-01	6.98E-01	5.68E-01	6.51E-01	5.91E-01	5.94E-01
	FSIM	7.89E-01	7.63E-01	7.56E-01	7.83E-01	7.82E-01	6.96E-01	7.40E-01	7.01E-01	7.08E-01
Im 30	MEAN	2.94E+01	3.06E+01	2.20E+01	3.02E+01	2.83E+01	3.19E+01	2.98E+01	3.29E+01	3.15E+01
	MSE	1.80E+03	2.10E+03	3.87E+03	2.06E+03	1.84E+03	3.68E+03	2.56E+03	2.99E+03	3.44E+03
	STD	4.83E-01	1.10E+00	1.31E-01	1.67E+00	1.41E+00	1.09E+00	9.31E-01	1.81E+00	1.45E+00
	PSNR	1.65E+01	1.60E+01	1.25E+01	1.53E+01	1.59E+01	1.31E+01	1.49E+01	1.43E+01	1.33E+01
	SSIM	6.66E-01	6.14E-01	5.12E-01	5.52E-01	5.92E-01	4.63E-01	6.18E-01	5.37E-01	4.89E-01
	FSIM	7.91E-01	7.85E-01	7.45E-01	7.89E-01	7.88E-01	7.49E-01	7.63E-01	7.66E-01	7.46E-01

Table S11: *Results of AEFA variants at th=11.*

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 1	MEAN	4.86E+01	5.57E+01	3.50E+01	4.86E+01	4.80E+01	5.48E+01	5.09E+01	5.21E+01	5.07E+01
	MSE	7.87E+02	4.92E+02	4.27E+03	9.24E+02	5.78E+02	1.85E+03	8.95E+02	1.88E+03	8.85E+02
	STD	1.39E+00	2.02E+00	4.03E-02	3.22E+00	2.87E+00	2.15E+00	1.99E+00	2.90E+00	2.88E+00
	PSNR	1.97E+01	2.16E+01	1.25E+01	1.92E+01	2.07E+01	1.57E+01	1.89E+01	1.62E+01	1.99E+01
	SSIM	7.19E-01	7.81E-01	5.19E-01	7.06E-01	7.44E-01	5.16E-01	7.00E-01	5.45E-01	7.14E-01
	FSIM	7.90E-01	8.43E-01	6.20E-01	7.86E-01	8.20E-01	6.52E-01	7.77E-01	6.79E-01	8.00E-01
Im 2	MEAN	4.99E+01	5.46E+01	3.50E+01	4.80E+01	4.98E+01	5.35E+01	4.88E+01	5.34E+01	5.07E+01
	MSE	9.77E+02	5.15E+02	5.17E+03	8.74E+02	8.02E+02	1.13E+03	1.03E+03	8.58E+02	6.19E+02
	STD	1.44E+00	2.49E+00	1.27E-01	3.05E+00	3.23E+00	2.25E+00	1.74E+00	2.83E+00	3.59E+00
	PSNR	1.85E+01	2.14E+01	1.18E+01	1.93E+01	1.97E+01	1.79E+01	1.94E+01	1.98E+01	2.06E+01
	SSIM	8.38E-01	8.55E-01	6.31E-01	8.14E-01	8.36E-01	7.52E-01	7.97E-01	8.14E-01	8.37E-01
	FSIM	8.77E-01	8.95E-01	7.74E-01	8.82E-01	8.85E-01	8.45E-01	8.64E-01	8.71E-01	8.82E-01
Im 3	MEAN	4.71E+01	5.21E+01	3.50E+01	4.68E+01	4.88E+01	5.09E+01	4.82E+01	5.01E+01	5.05E+01
	MSE	7.97E+02	6.53E+02	3.33E+03	8.57E+02	9.15E+02	1.53E+03	9.15E+02	1.70E+03	1.05E+03
	STD	1.28E+00	1.91E+00	7.28E-02	2.61E+00	3.10E+00	1.86E+00	2.04E+00	2.22E+00	2.42E+00
	PSNR	1.93E+01	2.04E+01	1.38E+01	1.91E+01	1.87E+01	1.70E+01	1.90E+01	1.69E+01	1.84E+01
	SSIM	7.42E-01	7.79E-01	6.40E-01	7.42E-01	7.27E-01	6.67E-01	7.35E-01	6.74E-01	7.20E-01
	FSIM	8.02E-01	8.24E-01	7.50E-01	8.07E-01	7.90E-01	7.47E-01	7.96E-01	7.27E-01	7.65E-01
Im 4	MEAN	4.71E+01	5.20E+01	3.54E+01	4.81E+01	4.68E+01	5.14E+01	4.84E+01	4.97E+01	4.86E+01
	MSE	5.90E+02	5.50E+02	3.55E+03	1.23E+03	8.02E+02	3.35E+03	1.43E+03	3.23E+03	2.97E+03
	STD	1.66E+00	2.25E+00	3.23E-02	3.44E+00	2.59E+00	1.84E+00	1.61E+00	2.43E+00	2.57E+00
	PSNR	2.07E+01	2.14E+01	1.31E+01	1.91E+01	2.07E+01	1.37E+01	1.80E+01	1.34E+01	1.59E+01
	SSIM	7.35E-01	7.64E-01	5.61E-01	6.85E-01	7.29E-01	5.11E-01	6.42E-01	5.07E-01	5.55E-01
	FSIM	7.81E-01	8.02E-01	6.86E-01	7.77E-01	7.90E-01	6.52E-01	7.29E-01	6.62E-01	6.99E-01
Im 5	MEAN	4.86E+01	5.10E+01	3.46E+01	4.71E+01	4.81E+01	5.20E+01	4.85E+01	5.35E+01	4.98E+01
	MSE	9.89E+02	1.38E+03	5.04E+03	1.27E+03	1.13E+03	1.59E+03	1.01E+03	1.32E+03	6.78E+02
	STD	1.03E+00	2.51E+00	1.42E-01	2.67E+00	2.89E+00	1.96E+00	2.15E+00	2.51E+00	3.63E+00
	PSNR	1.90E+01	1.82E+01	1.16E+01	1.80E+01	1.88E+01	1.68E+01	1.92E+01	1.78E+01	2.11E+01
	SSIM	7.47E-01	7.27E-01	5.28E-01	6.67E-01	6.77E-01	5.63E-01	7.01E-01	6.39E-01	7.34E-01
	FSIM	8.09E-01	7.96E-01	6.77E-01	7.97E-01	8.00E-01	7.46E-01	7.87E-01	7.72E-01	8.26E-01
Im 6	MEAN	4.82E+01	5.60E+01	3.42E+01	4.73E+01	4.95E+01	5.41E+01	4.97E+01	5.05E+01	5.31E+01
	MSE	5.05E+02	4.63E+02	2.27E+03	4.75E+02	4.69E+02	4.35E+03	1.28E+03	2.90E+03	1.95E+03
	STD	1.48E+00	1.86E+00	5.71E-02	2.98E+00	3.34E+00	2.09E+00	1.63E+00	2.51E+00	3.01E+00
	PSNR	2.14E+01	2.18E+01	1.60E+01	2.16E+01	2.17E+01	1.42E+01	1.81E+01	1.51E+01	1.75E+01
	SSIM	8.28E-01	8.53E-01	5.90E-01	8.39E-01	8.37E-01	5.16E-01	7.70E-01	5.51E-01	6.85E-01
	FSIM	9.04E-01	9.24E-01	7.77E-01	9.14E-01	9.09E-01	7.29E-01	8.55E-01	7.77E-01	8.09E-01
Im 7	MEAN	4.70E+01	5.20E+01	3.50E+01	4.47E+01	4.67E+01	5.12E+01	4.81E+01	4.98E+01	5.13E+01
	MSE	4.64E+02	4.36E+02	2.09E+03	3.89E+02	5.07E+02	1.57E+03	1.81E+03	4.14E+03	9.87E+02
	STD	1.86E+00	2.03E+00	9.21E-02	2.61E+00	2.90E+00	1.92E+00	1.83E+00	2.40E+00	4.52E+00
	PSNR	2.21E+01	2.21E+01	1.99E+01	2.24E+01	2.16E+01	1.64E+01	1.80E+01	1.50E+01	1.87E+01
	SSIM	8.10E-01	8.34E-01	7.28E-01	8.26E-01	8.00E-01	6.22E-01	7.13E-01	5.53E-01	7.26E-01
	FSIM	8.72E-01	8.92E-01	8.20E-01	8.92E-01	8.73E-01	7.56E-01	8.15E-01	7.32E-01	8.07E-01

Table S12: Results of AEFA variants at $th=11$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 8	MEAN	4.81E+01	5.21E+01	3.53E+01	4.83E+01	4.90E+01	5.44E+01	4.97E+01	5.54E+01	5.21E+01
	MSE	4.86E+02	6.34E+02	2.48E+03	5.99E+02	4.76E+02	4.48E+03	8.88E+02	3.28E+03	1.50E+03
	STD	1.31E+00	2.12E+00	6.67E-03	3.01E+00	3.20E+00	1.99E+00	1.81E+00	2.48E+00	2.95E+00
	PSNR	2.16E+01	2.07E+01	1.72E+01	2.08E+01	2.17E+01	1.40E+01	1.95E+01	1.45E+01	1.68E+01
	SSIM	8.39E-01	7.99E-01	6.42E-01	8.08E-01	8.47E-01	4.74E-01	7.92E-01	5.16E-01	7.02E-01
	FSIM	9.11E-01	9.00E-01	8.00E-01	9.04E-01	9.21E-01	7.04E-01	8.95E-01	7.43E-01	8.39E-01
Im 9	MEAN	4.57E+01	5.19E+01	3.33E+01	4.76E+01	4.82E+01	5.10E+01	4.66E+01	4.83E+01	4.87E+01
	MSE	8.05E+02	7.33E+02	2.37E+03	6.35E+02	5.34E+02	2.16E+03	1.05E+03	1.22E+03	8.08E+02
	STD	1.36E+00	2.14E+00	1.24E-01	3.24E+00	3.08E+00	1.94E+00	2.00E+00	2.76E+00	2.62E+00
	PSNR	1.95E+01	2.00E+01	1.50E+01	2.02E+01	2.09E+01	1.57E+01	1.93E+01	1.83E+01	2.02E+01
	SSIM	7.23E-01	7.33E-01	6.35E-01	7.12E-01	7.27E-01	6.05E-01	7.17E-01	6.73E-01	7.24E-01
	FSIM	8.02E-01	8.14E-01	7.29E-01	7.89E-01	8.05E-01	7.03E-01	7.83E-01	7.62E-01	8.00E-01
Im 10	MEAN	4.73E+01	5.25E+01	3.51E+01	4.66E+01	4.69E+01	5.21E+01	4.71E+01	5.02E+01	4.93E+01
	MSE	5.64E+02	5.79E+02	2.52E+03	5.64E+02	5.81E+02	1.28E+03	1.05E+03	1.28E+03	6.05E+02
	STD	1.81E+00	2.50E+00	3.78E-01	2.65E+00	2.77E+00	1.99E+00	2.10E+00	2.96E+00	4.49E+00
	PSNR	2.07E+01	2.10E+01	1.49E+01	2.07E+01	2.07E+01	1.74E+01	1.91E+01	1.80E+01	2.10E+01
	SSIM	7.26E-01	7.44E-01	6.38E-01	7.15E-01	7.20E-01	6.39E-01	6.92E-01	6.52E-01	7.31E-01
	FSIM	8.19E-01	8.32E-01	7.20E-01	8.03E-01	8.11E-01	7.31E-01	7.94E-01	7.48E-01	8.16E-01
Im 11	MEAN	4.65E+01	4.78E+01	3.49E+01	4.59E+01	4.59E+01	5.11E+01	4.82E+01	5.08E+01	4.81E+01
	MSE	8.18E+02	8.89E+02	3.13E+03	8.76E+02	6.00E+02	1.28E+03	9.19E+02	1.32E+03	1.10E+03
	STD	1.49E+00	1.94E+00	2.53E-01	2.68E+00	2.77E+00	2.12E+00	3.13E+00	2.52E+00	2.31E+00
	PSNR	1.93E+01	1.92E+01	1.36E+01	1.92E+01	2.04E+01	1.75E+01	1.90E+01	1.77E+01	1.88E+01
	SSIM	7.26E-01	7.06E-01	5.76E-01	6.99E-01	7.26E-01	6.32E-01	6.96E-01	6.58E-01	6.68E-01
	FSIM	7.89E-01	7.84E-01	7.12E-01	7.66E-01	7.87E-01	7.18E-01	7.71E-01	7.62E-01	7.68E-01
Im 12	MEAN	4.58E+01	5.14E+01	3.50E+01	4.76E+01	4.74E+01	5.13E+01	4.67E+01	4.84E+01	4.90E+01
	MSE	6.21E+02	6.79E+02	2.76E+03	9.24E+02	7.30E+02	9.97E+02	1.40E+03	1.13E+03	1.01E+03
	STD	1.28E+00	1.78E+00	1.07E-02	3.15E+00	2.88E+00	2.03E+00	1.83E+00	2.63E+00	2.72E+00
	PSNR	2.12E+01	2.05E+01	1.44E+01	1.95E+01	2.01E+01	1.88E+01	1.82E+01	1.86E+01	1.90E+01
	SSIM	7.71E-01	7.52E-01	6.53E-01	7.40E-01	7.24E-01	6.78E-01	7.06E-01	7.00E-01	7.27E-01
	FSIM	8.48E-01	8.36E-01	7.73E-01	8.19E-01	8.15E-01	7.85E-01	8.01E-01	8.00E-01	8.18E-01
Im 13	MEAN	4.65E+01	4.89E+01	3.50E+01	4.73E+01	4.74E+01	5.15E+01	4.74E+01	5.11E+01	4.98E+01
	MSE	8.30E+02	5.54E+02	3.27E+03	6.24E+02	4.45E+02	9.10E+02	8.02E+02	7.25E+02	6.87E+02
	STD	1.63E+00	2.09E+00	2.91E-02	3.08E+00	3.18E+00	2.20E+00	2.12E+00	2.97E+00	3.94E+00
	PSNR	2.01E+01	2.14E+01	1.33E+01	2.10E+01	2.21E+01	1.89E+01	2.00E+01	1.99E+01	2.07E+01
	SSIM	7.76E-01	7.83E-01	6.04E-01	7.72E-01	7.90E-01	6.95E-01	7.29E-01	7.65E-01	7.62E-01
	FSIM	8.47E-01	8.60E-01	7.43E-01	8.47E-01	8.59E-01	7.82E-01	8.11E-01	8.36E-01	8.37E-01
Im 14	MEAN	4.59E+01	4.90E+01	3.50E+01	4.56E+01	4.54E+01	5.02E+01	4.60E+01	5.14E+01	4.84E+01
	MSE	4.73E+02	4.83E+02	3.87E+03	1.07E+03	1.57E+03	1.26E+03	1.23E+03	7.21E+02	1.04E+03
	STD	1.67E+00	2.33E+00	1.36E-01	2.68E+00	2.48E+00	1.75E+00	1.96E+00	2.56E+00	3.34E+00
	PSNR	2.21E+01	2.19E+01	1.25E+01	1.96E+01	1.74E+01	1.83E+01	1.79E+01	1.98E+01	1.91E+01
	SSIM	8.12E-01	8.07E-01	5.19E-01	7.27E-01	6.42E-01	6.62E-01	7.15E-01	7.41E-01	7.08E-01
	FSIM	8.63E-01	8.60E-01	7.52E-01	8.32E-01	8.01E-01	7.56E-01	8.18E-01	8.23E-01	8.11E-01

Table S13: *Results of AEFA variants at th=11.*

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 15	MEAN	4.71E+01	5.22E+01	3.50E+01	4.55E+01	4.75E+01	5.15E+01	4.61E+01	5.03E+01	4.83E+01
	MSE	1.44E+03	9.67E+02	4.17E+03	1.54E+03	1.06E+03	1.51E+03	1.06E+03	1.01E+03	1.27E+03
	STD	1.51E+00	2.53E+00	2.02E-01	2.66E+00	3.34E+00	2.56E+00	1.34E+00	2.78E+00	2.71E+00
	PSNR	1.75E+01	1.88E+01	1.21E+01	1.69E+01	1.88E+01	1.69E+01	1.94E+01	1.90E+01	1.91E+01
	SSIM	7.36E-01	7.99E-01	6.06E-01	6.94E-01	7.51E-01	6.57E-01	7.51E-01	7.48E-01	7.19E-01
	FSIM	8.70E-01	8.76E-01	7.80E-01	8.57E-01	8.67E-01	8.47E-01	8.73E-01	8.73E-01	8.80E-01
Im 16	MEAN	4.82E+01	5.40E+01	3.50E+01	5.03E+01	4.88E+01	5.21E+01	4.92E+01	5.19E+01	5.16E+01
	MSE	9.33E+02	5.04E+02	4.78E+03	7.94E+02	7.38E+02	1.06E+03	9.81E+02	8.90E+02	4.65E+02
	STD	1.22E+00	2.34E+00	1.66E-02	3.14E+00	2.95E+00	1.73E+00	2.00E+00	2.76E+00	3.15E+00
	PSNR	1.93E+01	2.16E+01	1.20E+01	1.98E+01	2.00E+01	1.87E+01	2.05E+01	1.90E+01	2.18E+01
	SSIM	8.35E-01	8.61E-01	6.34E-01	8.07E-01	8.14E-01	7.53E-01	8.35E-01	7.94E-01	8.64E-01
	FSIM	8.74E-01	8.97E-01	7.79E-01	8.74E-01	8.74E-01	8.49E-01	8.73E-01	8.55E-01	8.92E-01
Im 17	MEAN	4.62E+01	4.87E+01	3.50E+01	4.49E+01	4.57E+01	5.12E+01	4.57E+01	5.21E+01	4.76E+01
	MSE	1.35E+03	8.64E+02	3.75E+03	2.09E+03	2.40E+03	9.99E+02	9.52E+02	1.52E+03	1.07E+03
	STD	1.52E+00	1.81E+00	4.57E-01	2.49E+00	2.61E+00	2.45E+00	1.97E+00	3.19E+00	3.42E+00
	PSNR	1.83E+01	2.01E+01	1.24E+01	1.59E+01	1.50E+01	1.85E+01	1.96E+01	1.79E+01	1.87E+01
	SSIM	7.17E-01	7.99E-01	4.96E-01	6.01E-01	5.53E-01	7.80E-01	7.77E-01	7.65E-01	7.67E-01
	FSIM	8.39E-01	8.67E-01	7.71E-01	8.20E-01	8.19E-01	8.41E-01	8.82E-01	8.39E-01	8.75E-01
Im 18	MEAN	4.98E+01	5.13E+01	3.50E+01	4.84E+01	4.87E+01	5.29E+01	4.87E+01	5.29E+01	5.16E+01
	MSE	6.43E+02	5.34E+02	4.09E+03	9.53E+02	8.98E+02	1.10E+03	6.83E+02	7.96E+02	5.49E+02
	STD	1.91E+00	2.15E+00	6.48E-02	2.80E+00	2.72E+00	2.25E+00	1.96E+00	2.42E+00	3.41E+00
	PSNR	2.03E+01	2.14E+01	1.27E+01	1.97E+01	1.90E+01	1.81E+01	2.02E+01	1.98E+01	2.10E+01
	SSIM	8.68E-01	8.67E-01	6.85E-01	8.42E-01	8.28E-01	7.42E-01	8.27E-01	8.29E-01	8.43E-01
	FSIM	8.94E-01	8.98E-01	8.03E-01	8.82E-01	8.80E-01	8.39E-01	8.75E-01	8.75E-01	8.90E-01
Im 19	MEAN	5.01E+01	5.50E+01	3.50E+01	4.95E+01	4.81E+01	5.30E+01	4.85E+01	5.13E+01	5.15E+01
	MSE	6.03E+02	9.39E+02	3.04E+03	9.07E+02	7.04E+02	1.12E+03	4.63E+02	8.92E+02	6.78E+02
	STD	1.43E+00	2.18E+00	1.34E-01	3.13E+00	3.21E+00	2.05E+00	1.12E+00	2.63E+00	3.39E+00
	PSNR	2.07E+01	1.91E+01	1.35E+01	1.88E+01	2.00E+01	1.83E+01	2.20E+01	1.92E+01	2.06E+01
	SSIM	8.66E-01	8.49E-01	6.95E-01	8.24E-01	8.44E-01	7.65E-01	8.74E-01	8.14E-01	8.53E-01
	FSIM	8.93E-01	8.79E-01	8.04E-01	8.75E-01	8.82E-01	8.37E-01	9.07E-01	8.64E-01	8.77E-01
Im 20	MEAN	4.81E+01	5.01E+01	3.50E+01	4.67E+01	4.58E+01	5.20E+01	4.77E+01	5.31E+01	5.12E+01
	MSE	8.19E+02	8.24E+02	3.11E+03	9.28E+02	1.02E+03	1.48E+03	6.86E+02	1.73E+03	1.01E+03
	STD	1.65E+00	2.43E+00	6.82E-02	2.87E+00	2.84E+00	2.20E+00	1.81E+00	2.19E+00	3.26E+00
	PSNR	1.93E+01	1.92E+01	1.39E+01	1.89E+01	1.83E+01	1.69E+01	2.00E+01	1.60E+01	1.86E+01
	SSIM	7.21E-01	7.24E-01	6.03E-01	7.04E-01	7.05E-01	6.23E-01	7.33E-01	5.97E-01	6.92E-01
	FSIM	7.98E-01	7.98E-01	7.45E-01	7.89E-01	7.76E-01	7.42E-01	8.24E-01	7.22E-01	7.98E-01
Im 21	MEAN	4.90E+01	5.35E+01	3.50E+01	4.71E+01	4.77E+01	5.12E+01	4.86E+01	5.33E+01	5.12E+01
	MSE	6.63E+02	9.73E+02	3.49E+03	9.39E+02	7.81E+02	1.99E+03	1.15E+03	2.14E+03	1.49E+03
	STD	1.33E+00	2.71E+00	4.33E-02	2.86E+00	2.86E+00	1.95E+00	1.53E+00	2.41E+00	2.90E+00
	PSNR	2.02E+01	1.88E+01	1.30E+01	1.87E+01	1.93E+01	1.55E+01	1.93E+01	1.56E+01	1.77E+01
	SSIM	7.57E-01	7.21E-01	6.11E-01	7.18E-01	7.41E-01	5.78E-01	7.39E-01	5.89E-01	6.51E-01
	FSIM	8.16E-01	7.93E-01	7.30E-01	7.93E-01	7.95E-01	7.15E-01	8.13E-01	7.22E-01	7.68E-01

Table S14: Results of AEFA variants at $th=11$.

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 22	MEAN	4.77E+01	5.12E+01	3.50E+01	4.80E+01	4.79E+01	5.43E+01	4.90E+01	5.38E+01	5.14E+01
	MSE	5.82E+02	6.33E+02	2.57E+03	6.62E+02	6.68E+02	1.35E+03	8.36E+02	1.64E+03	9.94E+02
	STD	1.47E+00	2.27E+00	1.26E-01	3.12E+00	3.05E+00	2.20E+00	1.56E+00	3.03E+00	3.35E+00
	PSNR	2.08E+01	2.05E+01	1.41E+01	2.02E+01	1.99E+01	1.74E+01	1.96E+01	1.64E+01	1.88E+01
	SSIM	7.76E-01	7.55E-01	5.81E-01	7.45E-01	7.57E-01	6.51E-01	7.17E-01	6.23E-01	7.05E-01
	FSIM	8.31E-01	8.21E-01	7.38E-01	8.09E-01	8.15E-01	7.58E-01	8.19E-01	7.43E-01	7.87E-01
Im 23	MEAN	5.08E+01	5.21E+01	3.50E+01	4.92E+01	4.73E+01	5.23E+01	4.95E+01	5.34E+01	5.04E+01
	MSE	5.75E+02	8.43E+02	2.27E+03	6.63E+02	7.35E+02	1.99E+03	1.06E+03	2.19E+03	9.33E+02
	STD	2.02E+00	2.49E+00	1.85E-01	3.08E+00	2.91E+00	1.58E+00	2.29E+00	2.40E+00	3.12E+00
	PSNR	2.07E+01	1.93E+01	1.49E+01	2.00E+01	1.98E+01	1.58E+01	1.89E+01	1.55E+01	1.94E+01
	SSIM	7.68E-01	7.22E-01	6.24E-01	7.46E-01	7.35E-01	6.04E-01	7.10E-01	5.98E-01	7.12E-01
	FSIM	8.27E-01	7.92E-01	7.46E-01	8.11E-01	8.12E-01	7.20E-01	7.96E-01	7.13E-01	8.01E-01
Im 24	MEAN	4.89E+01	4.96E+01	3.50E+01	4.85E+01	4.74E+01	5.28E+01	4.79E+01	5.27E+01	5.12E+01
	MSE	7.38E+02	7.80E+02	2.16E+03	6.32E+02	7.34E+02	1.65E+03	7.28E+02	1.20E+03	8.79E+02
	STD	1.75E+00	1.62E+00	3.01E-01	2.73E+00	2.75E+00	2.00E+00	1.92E+00	1.93E+00	3.15E+00
	PSNR	1.95E+01	1.95E+01	1.52E+01	2.03E+01	1.96E+01	1.64E+01	2.01E+01	1.78E+01	1.89E+01
	SSIM	7.44E-01	7.46E-01	6.27E-01	7.52E-01	7.29E-01	6.41E-01	7.51E-01	6.90E-01	7.15E-01
	FSIM	7.98E-01	7.99E-01	7.52E-01	8.08E-01	7.90E-01	7.17E-01	8.27E-01	7.57E-01	7.95E-01
Im 25	MEAN	5.05E+01	5.69E+01	3.50E+01	4.92E+01	5.04E+01	5.60E+01	5.12E+01	5.25E+01	5.21E+01
	MSE	5.91E+02	7.31E+02	2.20E+03	7.34E+02	5.90E+02	1.34E+03	1.00E+03	2.07E+03	8.37E+02
	STD	1.68E+00	1.68E+00	8.87E-03	3.12E+00	3.45E+00	2.08E+00	1.96E+00	3.12E+00	2.84E+00
	PSNR	2.07E+01	2.00E+01	1.51E+01	1.97E+01	2.08E+01	1.71E+01	1.91E+01	1.53E+01	2.00E+01
	SSIM	7.90E-01	7.48E-01	6.05E-01	7.32E-01	7.54E-01	6.02E-01	7.17E-01	5.13E-01	7.54E-01
	FSIM	8.80E-01	8.49E-01	7.38E-01	8.44E-01	8.56E-01	7.68E-01	8.35E-01	6.91E-01	8.52E-01
Im 26	MEAN	4.71E+01	5.26E+01	3.50E+01	4.73E+01	4.76E+01	5.14E+01	4.81E+01	4.98E+01	5.03E+01
	MSE	1.02E+03	9.60E+02	3.33E+03	9.55E+02	1.06E+03	1.40E+03	9.05E+02	1.29E+03	5.80E+02
	STD	1.31E+00	2.35E+00	3.26E-02	2.83E+00	3.07E+00	2.20E+00	1.78E+00	2.37E+00	2.84E+00
	PSNR	1.83E+01	1.85E+01	1.35E+01	1.85E+01	1.81E+01	1.69E+01	1.94E+01	1.72E+01	2.09E+01
	SSIM	7.19E-01	7.33E-01	6.06E-01	7.10E-01	6.94E-01	6.64E-01	7.25E-01	6.59E-01	7.64E-01
	FSIM	7.81E-01	7.86E-01	7.43E-01	7.72E-01	7.77E-01	7.34E-01	8.07E-01	7.59E-01	8.22E-01
Im 27	MEAN	4.73E+01	5.31E+01	3.50E+01	4.79E+01	4.89E+01	5.09E+01	4.75E+01	5.22E+01	5.11E+01
	MSE	7.01E+02	7.76E+02	3.15E+03	8.66E+02	8.16E+02	2.43E+03	8.96E+02	1.58E+03	8.99E+02
	STD	1.49E+00	2.64E+00	8.95E-02	3.09E+00	3.13E+00	1.41E+00	1.61E+00	2.93E+00	2.76E+00
	PSNR	2.01E+01	1.96E+01	1.40E+01	1.90E+01	1.91E+01	1.50E+01	1.96E+01	1.76E+01	1.92E+01
	SSIM	7.58E-01	7.56E-01	6.38E-01	7.29E-01	7.29E-01	6.03E-01	7.61E-01	6.78E-01	7.36E-01
	FSIM	8.05E-01	7.97E-01	7.32E-01	7.86E-01	7.89E-01	6.78E-01	7.99E-01	7.46E-01	7.82E-01
Im 28	MEAN	4.82E+01	5.00E+01	3.50E+01	4.77E+01	4.74E+01	5.24E+01	4.79E+01	5.19E+01	5.16E+01
	MSE	8.40E+02	7.39E+02	2.44E+03	7.47E+02	5.98E+02	2.59E+03	9.97E+02	1.70E+03	7.90E+02
	STD	1.41E+00	1.83E+00	3.19E-02	3.04E+00	2.85E+00	1.80E+00	1.69E+00	2.05E+00	4.13E+00
	PSNR	1.91E+01	1.99E+01	1.48E+01	1.95E+01	2.07E+01	1.47E+01	1.86E+01	1.66E+01	1.94E+01
	SSIM	7.43E-01	7.98E-01	6.56E-01	7.62E-01	7.84E-01	5.88E-01	7.70E-01	6.71E-01	7.42E-01
	FSIM	8.03E-01	8.17E-01	7.65E-01	8.10E-01	8.28E-01	6.96E-01	8.14E-01	7.35E-01	8.01E-01

Table S15: *Results of AEFA variants at $th=11$.*

No.	Metrics	AEFA	iAEFA	iAEF	ObAEFA	QO-AEFA	MLAEFA	mAEFA	GAEFA-HK	GAEFA
Im 29	MEAN	4.78E+01	5.12E+01	3.50E+01	4.80E+01	4.88E+01	5.33E+01	4.93E+01	5.29E+01	5.13E+01
	MSE	5.98E+02	1.08E+03	1.95E+03	6.12E+02	5.65E+02	1.89E+03	1.10E+03	1.44E+03	1.65E+03
	STD	1.42E+00	2.36E+00	1.54E-01	3.32E+00	3.13E+00	1.90E+00	2.18E+00	2.20E+00	3.18E+00
	PSNR	2.09E+01	1.88E+01	1.61E+01	2.05E+01	2.08E+01	1.65E+01	1.91E+01	1.68E+01	1.62E+01
	SSIM	8.00E-01	7.46E-01	7.00E-01	7.82E-01	7.89E-01	6.56E-01	7.51E-01	6.71E-01	6.74E-01
	FSIM	8.44E-01	8.09E-01	7.78E-01	8.18E-01	8.33E-01	7.46E-01	8.06E-01	7.56E-01	7.60E-01
Im 30	MEAN	4.70E+01	5.04E+01	3.50E+01	4.72E+01	4.70E+01	5.19E+01	4.81E+01	5.36E+01	4.83E+01
	MSE	8.10E+02	6.36E+02	3.03E+03	1.36E+03	1.21E+03	2.45E+03	8.94E+02	2.00E+03	1.14E+03
	STD	1.31E+00	2.67E+00	4.63E-02	2.73E+00	2.72E+00	1.98E+00	1.92E+00	2.84E+00	2.67E+00
	PSNR	1.96E+01	2.05E+01	1.35E+01	1.74E+01	1.84E+01	1.47E+01	1.94E+01	1.55E+01	1.87E+01
	SSIM	7.50E-01	7.91E-01	4.99E-01	6.54E-01	6.91E-01	5.36E-01	7.52E-01	5.76E-01	7.10E-01
	FSIM	8.31E-01	8.54E-01	7.63E-01	8.15E-01	8.20E-01	7.82E-01	8.37E-01	7.88E-01	8.26E-01

1 Discussion with Other State-of-the-Art Algorithms

1.1 Discussion for threshold level 3

The results for the first 30-image datasets at $th = 3$ are summarized in Tables S16 to S20, showcasing the average values of various metrics: MEAN, FSIM, PSNR, SSIM, MSE, and STD. From these tables, several observations can be made:

AEO and AOA only excel in FSIM, PSNR, and MSE on 1, 1, and 1 images out of the 30 images, respectively. AOA also excels STD on 14 out of the 30 image datasets. CGSA provides better SSIM, and STD on 3, and 17 out of 30 images. ChOA excels in PSNR, and SSIM on 1, and 1 images. However, these algorithms do not achieve the best MEAN score on any images. Additionally, (ChOA, CGSA), and (AEO, AOA) do not provide the best FSIM, and SSIM on any images. MPSO and TACPSO do not provide the best results on any images.

FDB-SOS and MFO provide the best scores for FSIM, PSNR, SSIM, and MSE on 10, 5; 8, 2; 7, 3; and 8, 4 images, respectively, but MFO does not achieve the best values of MEAN and STD on any image datasets. FDB-SOS provides the best MEAN values on 11 images. Similarly, GAEFA-HK achieves top scores in MEAN, FSIM, PSNR, SSIM, and MSE on 19, 13, 17, 16, and 16 images out of the 30 image datasets, respectively. However, neither GAEFA-HK nor FDB-SOS achieves the smallest STD value on any dataset.

In this comparison, it is evident that GAEFA-HK outperforms other algorithms, leading in MEAN, FSIM, PSNR, SSIM, and MSE on 63.33%, 43.33%, 56.66%, 53.33%, and 53.33% of datasets, respectively. When individually compared with other algorithms, GAEFA-HK outperforms AEO, AOA, CGSA, ChOA, FDB-SOS, MFO, MPSO, and TACPSO on 96.31%, 96.31%, 96.31%, 96.59%, 45.68%, 82.78%, 100%, and 100% of 30 image datasets, respectively.

2 Discussion for threshold level 6

The results for the first 30-image datasets at $th = 6$ are summarized in Tables S21 to S25, which display the average values of various metrics: MEAN, FSIM, PSNR, SSIM, MSE, and STD. Several observations can be made from these tables:

AEO and AOA excel in MEAN and STD, securing the top positions on 1, 0; and 2, 6 images out of the 30 images, respectively. However, they do not achieve the best FSIM, PSNR, SSIM, and MSE values on any image dataset. CGSA and ChOA perform better in FSIM, PSNR, SSIM, MSE, and STD, securing the top spot on 9, 3; 10, 2; 9, 3; 10, 2; and 20, 0 images but do not find the best solutions for other metrics on any images. FDB-SOS provides the best values for MEAN, PSNR, MSE, and SSIM on 12, 3, 2, and 5 images, respectively, but it does not achieve the best score for FSIM on any image dataset. MFO only provides the best value of MEAN on 2 images. iAEFA provides the best values for MEAN, FSIM, MSE, PSNR, SSIM, and STD on 16, 19, 16, 15, 14, and 2 images out of 30-image datasets.

In this comparison, it is evident that iAEFA outperforms other algorithms, leading in MEAN, FSIM, PSNR, SSIM, and MSE on 53.33%, 63.66%, 50%, 46.66%, and 53.33% of datasets, respectively. When individually compared with other algorithms, iAEFA outperforms AEO, AOA, CGSA, ChOA, FDB-SOS, MFO, MPSO, and TACPSO on 98.74%, 100%, 52.49%, 87.49%, 72.49%, 97.44%, 100%, and 100% of 30-image datasets, respectively.

3 Discussion for threshold level 11

The results for the first 30-image datasets at $t_h = 11$ are summarized in Tables S26 to S30, where we present the average values of MEAN, FSIM, PSNR, SSIM, MSE, and STD. These tables reveal several key observations:

AOA provides better PSNR and STD values on 1 and 2 images, respectively, but it does not achieve the best results for other metrics on any images. FDB-SOS only excels in MEAN values on 17 images. CGSA and ChOA perform better in FSIM, PSNR, SSIM, MSE, and STD, securing the top spot on 4, 14; 4, 11; 3, 13; 4, 9; and 16, 1 image, respectively, but they do not find the best solutions for MEAN values

on any images. MFO, MPSO, and TACPSO do not give the best results for any metrics on any images, but MPSO provides the lowest STD value on 2 only two images. In contrast, iAEFA achieves the best values for MEAN, FSIM, MSE, PSNR, SSIM, and STD on 13, 12, 17, 14, 14, and 8 images out of the 30-image datasets.

In this comparison, it is evident that iAEFA outperforms other algorithms, leading in MEAN, FSIM, MSE, PSNR, and SSIM on 43.33%, 40%, 57.67%, 46.66%, and 46.67% of datasets, respectively. When individually compared with other algorithms, iAEFA outperforms AEO, AOA, CGSA, ChOA, FDB-SOS, MFO, MPSO, and TACPSO on 100%, 98.57%, 78.56%, 32.84%, 79.99%, 100%, 100%, and 100% of 30-image datasets, respectively.

Table S16: Results of AEFA variant and other algorithms at $th=3$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	GAEFA-HK
Im 1	MEAN	1.97E+01	1.87E+01	1.89E+01	1.72E+01	2.16E+01	1.78E+01	1.90E+01	1.90E+01	1.31E+01
	MSE	7.96E+03	7.33E+03	3.72E+03	5.03E+03	3.33E+03	2.68E+03	2.72E+04	2.62E+04	5.03E-01
	STD	3.96E-01	1.63E-01	2.54E-01	3.45E+00	1.03E+00	9.60E-01	8.19E-01	8.71E-01	7.23E-01
	PSNR	1.04E+01	1.08E+01	1.28E+01	1.19E+01	1.29E+01	1.43E+01	3.86E+00	4.06E+00	2.07E+01
	SSIM	4.56E-01	4.47E-01	5.67E-01	5.11E-01	5.32E-01	5.85E-01	1.84E-01	1.97E-01	4.46E+03
	FSIM	6.35E-01	6.29E-01	6.82E-01	6.55E-01	7.10E-01	7.11E-01	4.64E-01	4.71E-01	1.02E+00
Im 2	MEAN	2.01E+01	1.88E+01	1.78E+01	1.77E+01	2.06E+01	1.79E+01	1.92E+01	1.93E+01	1.40E+01
	MSE	5.75E+03	6.27E+03	3.41E+03	3.19E+03	4.14E+03	3.08E+03	2.70E+04	2.52E+04	6.62E-01
	STD	4.12E-01	3.22E-01	4.08E-01	3.64E+00	5.45E-01	1.03E+00	6.71E-01	7.54E-01	7.87E-01
	PSNR	1.14E+01	1.15E+01	1.35E+01	1.34E+01	1.27E+01	1.35E+01	3.91E+00	4.22E+00	2.14E+01
	SSIM	4.34E-01	4.94E-01	5.56E-01	5.71E-01	5.06E-01	5.69E-01	2.01E-01	2.28E-01	2.68E+03
	FSIM	6.14E-01	6.64E-01	6.94E-01	7.08E-01	6.77E-01	7.21E-01	4.81E-01	4.90E-01	7.74E-01
Im 3	MEAN	2.07E+01	1.87E+01	1.78E+01	1.76E+01	2.09E+01	1.81E+01	1.86E+01	1.97E+01	2.14E+01
	MSE	4.45E+03	6.29E+03	4.71E+03	4.35E+03	3.73E+03	3.65E+03	2.19E+04	2.33E+04	4.13E+03
	STD	7.11E-01	2.30E-01	2.90E-01	3.58E+00	7.31E-01	1.06E+00	5.19E-01	9.42E-01	1.12E+00
	PSNR	1.18E+01	1.14E+01	1.21E+01	1.20E+01	1.24E+01	1.28E+01	4.80E+00	4.49E+00	1.44E+01
	SSIM	4.35E-01	4.71E-01	4.94E-01	5.19E-01	4.79E-01	5.11E-01	2.40E-01	2.20E-01	6.21E-01
	FSIM	6.96E-01	6.81E-01	7.06E-01	7.06E-01	7.53E-01	7.28E-01	4.93E-01	4.93E-01	7.58E-01
Im 4	MEAN	2.12E+01	1.97E+01	1.85E+01	1.81E+01	2.14E+01	1.78E+01	2.02E+01	2.02E+01	1.98E+01
	MSE	4.50E+03	5.26E+03	4.18E+03	3.92E+03	4.28E+03	3.27E+03	2.24E+04	1.93E+04	5.30E+03
	STD	5.06E-01	1.80E-01	3.04E-01	3.74E+00	6.70E-01	1.06E+00	8.03E-01	9.07E-01	7.68E-01
	PSNR	1.17E+01	1.12E+01	1.22E+01	1.26E+01	1.19E+01	1.37E+01	4.69E+00	5.38E+00	1.10E+01
	SSIM	4.16E-01	4.02E-01	5.29E-01	5.16E-01	4.22E-01	5.02E-01	1.69E-01	2.30E-01	3.93E-01
	FSIM	6.50E-01	5.87E-01	6.23E-01	6.21E-01	6.58E-01	6.45E-01	3.90E-01	4.30E-01	6.13E-01
Im 5	MEAN	2.14E+01	2.04E+01	1.92E+01	1.86E+01	2.20E+01	1.87E+01	2.05E+01	2.04E+01	1.40E+01
	MSE	3.25E+03	3.55E+03	4.58E+03	4.96E+03	2.88E+03	3.51E+03	2.44E+04	2.49E+04	4.77E-01
	STD	4.53E-01	5.24E-01	3.36E-01	3.86E+00	5.10E-01	1.18E+00	9.24E-01	8.94E-01	6.68E-01
	PSNR	1.31E+01	1.30E+01	1.17E+01	1.17E+01	1.35E+01	1.28E+01	4.29E+00	4.23E+00	2.15E+01
	SSIM	4.21E-01	4.69E-01	5.29E-01	4.81E-01	4.68E-01	4.57E-01	1.99E-01	1.93E-01	4.96E+03
	FSIM	6.53E-01	6.28E-01	6.57E-01	6.50E-01	6.80E-01	6.47E-01	4.34E-01	4.26E-01	8.58E-01
Im 6	MEAN	2.25E+01	2.11E+01	2.05E+01	1.99E+01	2.09E+01	1.90E+01	2.15E+01	2.05E+01	2.28E+01
	MSE	2.71E+03	7.29E+03	1.56E+03	2.14E+03	1.41E+03	4.69E+03	9.20E+03	9.08E+03	1.93E+03
	STD	4.32E-01	4.00E-01	2.95E-01	4.07E+00	6.00E-01	1.32E+00	9.69E-01	1.05E+00	9.22E-01
	PSNR	1.53E+01	1.19E+01	1.65E+01	1.52E+01	1.66E+01	1.38E+01	8.75E+00	8.65E+00	1.70E+01
	SSIM	5.52E-01	3.71E-01	6.44E-01	5.93E-01	6.27E-01	4.84E-01	2.12E-01	2.13E-01	6.57E-01
	FSIM	8.01E-01	6.51E-01	8.16E-01	7.49E-01	8.53E-01	7.34E-01	4.04E-01	4.08E-01	7.64E-01
Im 7	MEAN	2.17E+01	2.00E+01	1.85E+01	1.86E+01	2.23E+01	1.87E+01	2.06E+01	2.07E+01	1.06E+01
	MSE	4.07E+03	7.76E+03	4.14E+03	3.79E+03	1.17E+03	4.58E+03	1.01E+04	1.09E+04	6.37E-01
	STD	7.26E-01	5.77E-01	1.35E-01	3.81E+00	6.49E-01	1.12E+00	1.04E+00	1.08E+00	6.13E-01
	PSNR	1.52E+01	1.12E+01	1.42E+01	1.38E+01	1.75E+01	1.43E+01	8.17E+00	7.90E+00	1.91E+01
	SSIM	5.43E-01	3.85E-01	5.26E-01	5.36E-01	6.67E-01	5.27E-01	2.65E-01	2.40E-01	4.39E+03
	FSIM	7.37E-01	6.60E-01	6.93E-01	6.84E-01	7.36E-01	7.35E-01	5.26E-01	5.21E-01	8.09E-01

Table S17: *Results of AEFA variant and other algorithms at $th=3$.*

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	GAEFA-HK
Im 8	MEAN	2.16E+01	2.14E+01	2.02E+01	1.98E+01	1.99E+01	1.91E+01	2.16E+01	2.08E+01	2.26E+01
	MSE	7.16E+03	6.15E+03	1.64E+03	3.31E+03	1.45E+03	2.09E+03	8.84E+03	1.04E+04	3.07E+03
	STD	3.97E-01	6.25E-01	2.76E-01	4.14E+00	5.37E-01	1.13E+00	8.64E-01	1.02E+00	1.06E+00
	PSNR	1.17E+01	1.21E+01	1.64E+01	1.38E+01	1.65E+01	1.61E+01	8.91E+00	8.06E+00	1.38E+01
	SSIM	3.43E-01	3.82E-01	6.80E-01	5.32E-01	6.30E-01	6.12E-01	2.27E-01	1.56E-01	5.68E-01
	FSIM	6.58E-01	6.52E-01	8.16E-01	6.97E-01	8.45E-01	7.96E-01	4.28E-01	3.72E-01	6.88E-01
Im 9	MEAN	1.93E+01	1.88E+01	1.77E+01	1.66E+01	2.06E+01	1.78E+01	1.91E+01	1.88E+01	1.24E+01
	MSE	4.58E+03	4.22E+03	3.37E+03	4.31E+03	2.91E+03	2.62E+03	3.08E+04	3.30E+04	5.27E-01
	STD	2.60E-01	2.42E-01	2.71E-01	3.53E+00	5.82E-01	1.19E+00	7.62E-01	7.56E-01	6.71E-01
	PSNR	1.17E+01	1.23E+01	1.33E+01	1.23E+01	1.39E+01	1.44E+01	3.30E+00	2.99E+00	1.97E+01
	SSIM	4.75E-01	5.18E-01	5.78E-01	5.66E-01	5.62E-01	5.96E-01	1.65E-01	1.38E-01	3.48E+03
	FSIM	6.19E-01	6.35E-01	6.80E-01	6.72E-01	6.79E-01	7.02E-01	4.61E-01	4.60E-01	7.94E-01
Im 10	MEAN	1.95E+01	1.91E+01	1.80E+01	1.72E+01	1.90E+01	1.86E+01	1.94E+01	1.90E+01	2.08E+01
	MSE	4.59E+03	4.39E+03	3.37E+03	3.04E+03	2.35E+03	2.40E+03	3.12E+04	3.13E+04	3.21E+03
	STD	3.12E-01	1.77E-01	1.77E-01	3.62E+00	5.74E-01	1.12E+00	7.65E-01	8.53E-01	6.74E-01
	PSNR	1.18E+01	1.23E+01	1.36E+01	1.39E+01	1.50E+01	1.46E+01	3.24E+00	3.23E+00	1.11E+01
	SSIM	4.89E-01	5.34E-01	5.55E-01	5.82E-01	5.93E-01	6.13E-01	1.58E-01	1.56E-01	3.93E-01
	FSIM	6.14E-01	6.46E-01	6.72E-01	6.89E-01	6.94E-01	6.97E-01	4.55E-01	4.55E-01	6.10E-01
Im 11	MEAN	1.95E+01	1.87E+01	1.81E+01	1.78E+01	2.09E+01	1.81E+01	1.88E+01	1.89E+01	2.12E+01
	MSE	6.16E+03	6.41E+03	3.07E+03	3.41E+03	3.15E+03	2.88E+03	3.00E+04	2.76E+04	3.66E+03
	STD	3.27E-01	1.75E-01	2.92E-01	3.68E+00	7.80E-01	1.06E+00	7.52E-01	5.72E-01	6.34E-01
	PSNR	1.05E+01	1.13E+01	1.36E+01	1.31E+01	1.32E+01	1.41E+01	3.37E+00	3.74E+00	1.32E+01
	SSIM	3.75E-01	5.01E-01	5.91E-01	5.36E-01	5.51E-01	5.81E-01	1.49E-01	1.85E-01	4.61E-01
	FSIM	5.83E-01	6.76E-01	7.30E-01	6.91E-01	7.31E-01	7.26E-01	4.77E-01	4.79E-01	5.86E-01
Im 12	MEAN	2.18E+01	1.99E+01	1.87E+01	1.86E+01	2.22E+01	1.80E+01	2.00E+01	1.96E+01	1.31E+01
	MSE	3.80E+03	3.35E+03	3.31E+03	3.51E+03	3.90E+03	3.31E+03	2.12E+04	2.03E+04	6.88E-01
	STD	6.35E-01	5.12E-01	1.48E-01	3.76E+00	5.37E-01	1.05E+00	1.02E+00	1.07E+00	7.91E-01
	PSNR	1.24E+01	1.32E+01	1.38E+01	1.33E+01	1.23E+01	1.32E+01	4.92E+00	5.14E+00	2.16E+01
	SSIM	6.05E-01	5.24E-01	5.21E-01	5.81E-01	6.68E-01	5.02E-01	1.16E-01	1.47E-01	2.35E+03
	FSIM	7.86E-01	7.95E-01	7.86E-01	7.58E-01	7.80E-01	7.85E-01	3.98E-01	4.17E-01	7.72E-01
Im 13	MEAN	2.16E+01	2.02E+01	1.90E+01	1.98E+01	2.10E+01	1.89E+01	2.11E+01	2.07E+01	2.25E+01
	MSE	3.01E+03	3.85E+03	3.49E+03	5.38E+03	1.88E+03	2.91E+03	2.69E+04	2.89E+04	2.62E+03
	STD	3.70E-01	1.01E-01	2.42E-01	4.03E+00	4.38E-01	1.33E+00	9.10E-01	8.98E-01	9.70E-01
	PSNR	1.37E+01	1.27E+01	1.29E+01	1.18E+01	1.54E+01	1.38E+01	3.92E+00	3.57E+00	1.41E+01
	SSIM	4.65E-01	4.19E-01	4.86E-01	4.54E-01	5.41E-01	5.22E-01	1.27E-01	1.02E-01	5.40E-01
	FSIM	6.02E-01	5.60E-01	5.92E-01	5.57E-01	6.30E-01	6.44E-01	4.09E-01	4.08E-01	7.04E-01
Im 14	MEAN	2.13E+01	1.98E+01	1.94E+01	2.01E+01	2.22E+01	1.81E+01	2.06E+01	1.99E+01	1.29E+01
	MSE	2.90E+03	2.47E+03	4.05E+03	4.71E+03	2.49E+03	4.17E+03	2.32E+04	2.57E+04	4.99E-01
	STD	4.36E-01	2.60E-01	1.13E-01	4.13E+00	5.95E-01	1.02E+00	7.81E-01	8.35E-01	6.85E-01
	PSNR	1.39E+01	1.46E+01	1.31E+01	1.21E+01	1.45E+01	1.24E+01	4.59E+00	4.09E+00	2.09E+01
	SSIM	5.52E-01	6.68E-01	6.59E-01	6.61E-01	6.57E-01	5.90E-01	3.09E-01	2.58E-01	3.58E+03
	FSIM	7.55E-01	7.85E-01	7.77E-01	7.61E-01	8.06E-01	7.65E-01	5.90E-01	5.77E-01	7.76E-01

Table S18: Results of AEFA variant and other algorithms at $th=3$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	GAEFA-HK
Im 15	MEAN	2.17E+01	2.01E+01	2.04E+01	1.93E+01	2.05E+01	1.90E+01	2.01E+01	2.05E+01	2.24E+01
	MSE	2.41E+03	2.75E+03	3.50E+03	4.78E+03	3.83E+03	2.86E+03	2.80E+04	2.79E+04	3.56E+03
	STD	6.10E-01	3.49E-01	4.27E-01	3.93E+00	5.54E-01	1.16E+00	8.20E-01	9.14E-01	5.12E-01
	PSNR	1.47E+01	1.41E+01	1.31E+01	1.23E+01	1.25E+01	1.40E+01	3.69E+00	3.73E+00	1.42E+01
	SSIM	7.04E-01	6.73E-01	6.59E-01	6.69E-01	7.23E-01	6.64E-01	2.18E-01	2.20E-01	5.44E-01
	FSIM	8.13E-01	7.92E-01	7.99E-01	7.68E-01	8.02E-01	8.14E-01	5.75E-01	5.71E-01	7.30E-01
Im 16	MEAN	2.16E+01	1.93E+01	1.87E+01	1.85E+01	2.27E+01	1.74E+01	2.03E+01	2.04E+01	1.44E+01
	MSE	3.29E+03	9.70E+03	3.25E+03	5.93E+03	8.74E+02	3.64E+03	1.59E+04	1.59E+04	5.71E-01
	STD	6.86E-01	3.42E-01	3.34E-01	3.79E+00	9.13E-01	9.78E-01	1.24E+00	1.26E+00	7.28E-01
	PSNR	1.61E+01	9.62E+00	1.35E+01	1.12E+01	1.87E+01	1.25E+01	6.29E+00	6.20E+00	2.14E+01
	SSIM	6.67E-01	4.40E-01	5.41E-01	5.48E-01	7.84E-01	4.17E-01	2.49E-01	2.35E-01	3.38E+03
	FSIM	7.60E-01	6.38E-01	7.76E-01	7.14E-01	8.12E-01	7.96E-01	5.53E-01	5.32E-01	5.06E-01
Im 17	MEAN	2.21E+01	1.96E+01	1.94E+01	1.94E+01	2.08E+01	1.88E+01	2.05E+01	2.05E+01	2.24E+01
	MSE	2.64E+03	2.44E+03	3.01E+03	6.99E+03	3.51E+03	3.10E+03	2.89E+04	2.86E+04	2.48E+03
	STD	4.78E-01	3.82E-01	2.51E-01	3.85E+00	6.52E-01	1.11E+00	9.27E-01	8.13E-01	1.24E+00
	PSNR	1.41E+01	1.45E+01	1.42E+01	1.08E+01	1.30E+01	1.36E+01	3.57E+00	3.59E+00	1.44E+01
	SSIM	6.82E-01	6.53E-01	6.99E-01	6.32E-01	7.25E-01	6.29E-01	2.16E-01	2.18E-01	5.64E-01
	FSIM	8.12E-01	7.73E-01	7.95E-01	7.40E-01	8.05E-01	7.96E-01	5.77E-01	5.76E-01	7.30E-01
Im 18	MEAN	2.17E+01	1.97E+01	1.97E+01	2.01E+01	2.24E+01	1.85E+01	2.09E+01	2.04E+01	1.49E+01
	MSE	2.72E+03	2.65E+03	3.76E+03	4.30E+03	2.13E+03	2.99E+03	3.16E+04	3.00E+04	6.14E-01
	STD	4.77E-01	3.89E-01	1.71E-01	4.11E+00	4.99E-01	1.08E+00	9.97E-01	1.07E+00	7.45E-01
	PSNR	1.40E+01	1.41E+01	1.27E+01	1.27E+01	1.49E+01	1.36E+01	3.15E+00	3.48E+00	2.12E+01
	SSIM	6.29E-01	6.88E-01	6.68E-01	6.94E-01	6.82E-01	6.74E-01	1.68E-01	1.99E-01	2.45E+03
	FSIM	7.79E-01	7.71E-01	7.73E-01	7.82E-01	8.11E-01	7.90E-01	5.34E-01	5.47E-01	9.28E-01
Im 19	MEAN	2.03E+01	1.98E+01	1.90E+01	1.89E+01	2.10E+01	1.83E+01	2.04E+01	1.99E+01	2.19E+01
	MSE	2.76E+03	4.45E+03	4.36E+03	4.13E+03	2.40E+03	2.63E+03	2.40E+04	2.83E+04	2.60E+03
	STD	4.72E-01	2.04E-01	2.27E-01	3.85E+00	7.81E-01	1.07E+00	9.04E-01	9.11E-01	7.38E-01
	PSNR	1.38E+01	1.23E+01	1.24E+01	1.25E+01	1.44E+01	1.42E+01	4.47E+00	3.67E+00	1.43E+01
	SSIM	4.87E-01	4.73E-01	5.24E-01	5.25E-01	5.51E-01	5.62E-01	2.11E-01	1.36E-01	5.75E-01
	FSIM	6.71E-01	6.75E-01	7.09E-01	6.95E-01	7.23E-01	7.31E-01	5.08E-01	4.48E-01	7.10E-01
Im 20	MEAN	2.11E+01	2.03E+01	1.88E+01	1.91E+01	2.23E+01	1.86E+01	2.08E+01	2.00E+01	1.34E+01
	MSE	2.84E+03	3.35E+03	3.65E+03	4.86E+03	1.95E+03	2.64E+03	2.45E+04	2.24E+04	5.74E-01
	STD	4.38E-01	2.82E-01	2.23E-01	3.96E+00	7.43E-01	1.52E+00	9.54E-01	7.81E-01	7.21E-01
	PSNR	1.39E+01	1.30E+01	1.33E+01	1.17E+01	1.52E+01	1.41E+01	4.28E+00	4.69E+00	1.96E+01
	SSIM	5.06E-01	5.08E-01	5.36E-01	5.42E-01	5.62E-01	5.40E-01	1.53E-01	1.90E-01	2.83E+03
	FSIM	6.88E-01	6.84E-01	7.09E-01	6.94E-01	7.40E-01	7.29E-01	4.60E-01	4.74E-01	7.31E-01
Im 21	MEAN	2.10E+01	1.97E+01	1.91E+01	1.87E+01	2.09E+01	1.86E+01	2.08E+01	2.04E+01	2.24E+01
	MSE	3.43E+03	4.40E+03	3.61E+03	4.23E+03	1.91E+03	2.41E+03	2.35E+04	2.25E+04	3.58E+03
	STD	4.03E-01	1.79E-01	2.17E-01	3.87E+00	6.76E-01	1.07E+00	8.78E-01	9.44E-01	7.76E-01
	PSNR	1.32E+01	1.18E+01	1.31E+01	1.25E+01	1.53E+01	1.49E+01	4.50E+00	4.85E+00	1.29E+01
	SSIM	5.00E-01	4.18E-01	5.50E-01	5.43E-01	5.67E-01	5.85E-01	1.65E-01	1.86E-01	5.20E-01
	FSIM	6.85E-01	6.25E-01	7.04E-01	6.82E-01	7.35E-01	7.36E-01	4.69E-01	4.91E-01	6.89E-01

Table S19: Results of AEFA variant and other algorithms at $th=3$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	GAEFA-HK
Im 22	MEAN	2.08E+01	2.02E+01	1.91E+01	1.85E+01	2.05E+01	1.83E+01	2.08E+01	2.00E+01	2.22E+01
	MSE	3.18E+03	3.89E+03	4.16E+03	3.14E+03	3.56E+03	3.36E+03	2.48E+04	2.50E+04	1.99E+03
	STD	3.49E-01	3.96E-01	1.97E-01	3.80E+00	5.97E-01	1.05E+00	9.64E-01	7.83E-01	5.12E-01
	PSNR	1.37E+01	1.25E+01	1.25E+01	1.36E+01	1.42E+01	1.38E+01	4.22E+00	4.22E+00	1.57E+01
	SSIM	5.25E-01	4.83E-01	5.58E-01	5.65E-01	6.13E-01	5.48E-01	1.60E-01	1.59E-01	5.44E-01
	FSIM	6.83E-01	6.69E-01	6.97E-01	7.00E-01	7.30E-01	7.32E-01	4.29E-01	4.31E-01	6.99E-01
Im 23	MEAN	2.04E+01	1.97E+01	1.94E+01	1.87E+01	2.08E+01	1.82E+01	2.00E+01	2.05E+01	2.21E+01
	MSE	3.38E+03	3.99E+03	2.99E+03	3.35E+03	1.51E+03	2.37E+03	2.63E+04	2.39E+04	2.58E+03
	STD	3.80E-01	2.39E-01	2.12E-01	3.88E+00	7.04E-01	9.77E-01	8.25E-01	9.07E-01	9.69E-01
	PSNR	1.34E+01	1.23E+01	1.39E+01	1.34E+01	1.44E+01	1.46E+01	4.01E+00	4.49E+00	1.63E+01
	SSIM	5.24E-01	4.99E-01	5.87E-01	5.72E-01	5.71E-01	6.00E-01	1.51E-01	1.90E-01	6.19E-01
	FSIM	6.60E-01	6.51E-01	7.13E-01	6.88E-01	6.89E-01	7.41E-01	4.80E-01	4.93E-01	7.55E-01
Im 24	MEAN	2.27E+01	2.13E+01	2.02E+01	2.09E+01	2.14E+01	1.94E+01	2.14E+01	2.10E+01	2.29E+01
	MSE	2.12E+03	3.27E+03	4.56E+03	3.82E+03	3.38E+03	3.62E+03	2.54E+04	2.61E+04	1.84E+03
	STD	5.15E-01	3.49E-01	2.80E-01	4.27E+00	4.50E-01	1.11E+00	8.95E-01	1.11E+00	5.06E-01
	PSNR	1.51E+01	1.33E+01	1.22E+01	1.30E+01	1.31E+01	1.28E+01	4.13E+00	4.01E+00	1.55E+01
	SSIM	5.41E-01	4.54E-01	4.59E-01	4.89E-01	5.67E-01	4.78E-01	1.02E-01	9.23E-02	4.52E-01
	FSIM	7.20E-01	6.25E-01	6.35E-01	6.50E-01	6.27E-01	6.56E-01	3.62E-01	3.54E-01	7.40E-01
Im 25	MEAN	2.19E+01	1.94E+01	1.90E+01	1.85E+01	2.08E+01	1.82E+01	2.03E+01	2.00E+01	2.22E+01
	MSE	1.98E+03	2.90E+03	3.21E+03	4.38E+03	2.48E+03	2.07E+03	2.68E+04	2.65E+04	1.72E+03
	STD	8.45E-01	3.76E-01	2.39E-01	3.82E+00	6.95E-01	1.08E+00	1.06E+00	8.74E-01	1.24E+00
	PSNR	1.52E+01	1.36E+01	1.37E+01	1.23E+01	1.58E+01	1.51E+01	3.92E+00	4.01E+00	1.44E+01
	SSIM	5.89E-01	5.33E-01	5.92E-01	5.60E-01	5.64E-01	5.86E-01	1.84E-01	1.86E-01	6.26E-01
	FSIM	7.39E-01	6.90E-01	7.26E-01	6.98E-01	7.23E-01	7.32E-01	4.69E-01	4.80E-01	7.45E-01
Im 26	MEAN	2.09E+01	1.98E+01	1.85E+01	1.88E+01	2.07E+01	1.84E+01	2.02E+01	1.96E+01	2.25E+01
	MSE	2.41E+03	3.26E+03	3.94E+03	5.88E+03	2.27E+03	2.49E+03	2.10E+04	2.55E+04	1.41E+03
	STD	5.00E-01	2.18E-01	3.71E-01	3.85E+00	9.74E-01	1.22E+00	8.43E-01	9.85E-01	8.84E-01
	PSNR	1.49E+01	1.32E+01	1.27E+01	1.17E+01	1.49E+01	1.44E+01	4.94E+00	4.10E+00	1.67E+01
	SSIM	6.00E-01	5.36E-01	5.69E-01	5.40E-01	6.97E-01	5.91E-01	2.39E-01	1.69E-01	6.14E-01
	FSIM	6.95E-01	6.70E-01	7.11E-01	6.69E-01	7.42E-01	7.40E-01	4.99E-01	4.17E-01	7.12E-01
Im 27	MEAN	2.16E+01	1.98E+01	1.93E+01	1.90E+01	2.12E+01	1.89E+01	2.07E+01	1.97E+01	2.18E+01
	MSE	2.11E+03	3.81E+03	3.64E+03	4.03E+03	2.45E+03	2.72E+03	2.24E+04	2.48E+04	1.90E+03
	STD	6.11E-01	3.23E-01	4.88E-01	3.96E+00	6.06E-01	1.53E+00	9.25E-01	7.97E-01	9.28E-01
	PSNR	1.53E+01	1.26E+01	1.31E+01	1.25E+01	1.56E+01	1.42E+01	4.86E+00	4.22E+00	1.47E+01
	SSIM	5.83E-01	5.17E-01	5.78E-01	5.67E-01	5.91E-01	6.00E-01	2.19E-01	1.74E-01	6.07E-01
	FSIM	7.10E-01	6.53E-01	6.96E-01	6.74E-01	7.03E-01	7.10E-01	4.83E-01	4.58E-01	7.12E-01
Im 28	MEAN	2.13E+01	1.98E+01	1.95E+01	1.88E+01	2.10E+01	1.83E+01	2.07E+01	2.01E+01	2.20E+01
	MSE	2.39E+03	3.85E+03	3.10E+03	4.38E+03	1.66E+03	2.59E+03	2.56E+04	2.31E+04	2.60E+03
	STD	5.12E-01	3.60E-01	3.93E-01	3.84E+00	8.04E-01	1.28E+00	8.92E-01	7.26E-01	7.38E-01
	PSNR	1.48E+01	1.26E+01	1.37E+01	1.23E+01	1.43E+01	1.42E+01	4.10E+00	4.57E+00	1.59E+01
	SSIM	5.78E-01	5.19E-01	6.00E-01	5.68E-01	6.12E-01	5.80E-01	1.54E-01	1.95E-01	5.75E-01
	FSIM	7.23E-01	6.65E-01	7.32E-01	6.93E-01	7.10E-01	7.35E-01	4.56E-01	4.79E-01	7.59E-01

Table S20: Results of AEFA variant and other algorithms at $th=3$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	GAEFA-HK
Im 29	MEAN	2.01E+01	1.98E+01	1.86E+01	1.82E+01	2.01E+01	1.82E+01	1.99E+01	1.99E+01	2.12E+01
	MSE	3.54E+03	3.56E+03	3.94E+03	3.90E+03	2.17E+03	2.00E+03	2.43E+04	2.18E+04	3.15E+03
	STD	2.61E-01	2.32E-01	2.56E-01	3.84E+00	4.50E-01	1.00E+00	8.17E-01	7.63E-01	6.36E-01
	PSNR	1.29E+01	1.29E+01	1.26E+01	1.30E+01	1.51E+01	1.53E+01	4.30E+00	4.83E+00	1.34E+01
	SSIM	5.37E-01	5.39E-01	5.93E-01	6.04E-01	6.11E-01	6.36E-01	2.17E-01	2.64E-01	5.74E-01
	FSIM	6.74E-01	6.67E-01	7.05E-01	7.04E-01	7.33E-01	7.45E-01	5.31E-01	5.37E-01	6.95E-01
Im 30	MEAN	2.10E+01	1.97E+01	1.86E+01	1.86E+01	1.96E+01	1.82E+01	2.04E+01	1.98E+01	2.21E+01
	MSE	3.85E+03	5.10E+03	3.76E+03	2.64E+03	2.83E+03	2.67E+03	1.80E+04	1.67E+04	2.58E+03
	STD	4.12E-01	3.17E-01	2.52E-01	3.87E+00	6.91E-01	8.55E-01	9.19E-01	7.65E-01	7.31E-01
	PSNR	1.27E+01	1.15E+01	1.26E+01	1.43E+01	1.40E+01	1.41E+01	5.69E+00	5.98E+00	1.38E+01
	SSIM	4.46E-01	4.07E-01	4.66E-01	5.56E-01	4.80E-01	5.07E-01	2.81E-01	3.24E-01	4.45E-01
	FSIM	7.54E-01	7.34E-01	7.24E-01	7.27E-01	7.79E-01	7.63E-01	5.39E-01	5.39E-01	7.25E-01

Table S21: Results of AEFA variant and other algorithms at $th=6$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 1	MEAN	3.37E+01	3.14E+01	2.98E+01	2.82E+01	3.28E+01	2.70E+01	3.08E+01	3.06E+01	3.40E+01
	MSE	3.71E+03	3.98E+03	1.27E+03	1.63E+03	3.85E+03	2.84E+03	2.17E+04	1.81E+04	1.14E+03
	STD	1.13E+00	6.88E-01	4.99E-01	5.82E+00	8.21E-01	1.60E+00	9.85E-01	1.05E+00	1.42E+00
	PSNR	1.28E+01	1.27E+01	1.76E+01	1.65E+01	1.25E+01	1.46E+01	4.82E+00	5.68E+00	1.79E+01
	SSIM	4.70E-01	4.83E-01	6.48E-01	6.36E-01	4.48E-01	5.65E-01	1.84E-01	2.55E-01	6.68E-01
	FSIM	6.58E-01	6.30E-01	7.24E-01	6.96E-01	6.65E-01	6.96E-01	3.98E-01	4.31E-01	6.70E-01
Im 2	MEAN	3.41E+01	3.16E+01	3.09E+01	2.87E+01	3.47E+01	2.70E+01	3.15E+01	3.06E+01	1.61E+01
	MSE	2.33E+03	1.37E+03	1.55E+03	2.21E+03	2.39E+03	2.88E+03	2.33E+04	2.17E+04	6.26E-01
	STD	9.53E-01	1.10E+00	6.34E-01	6.06E+00	9.16E-01	1.79E+00	1.39E+00	1.13E+00	7.31E-01
	PSNR	1.45E+01	1.76E+01	1.65E+01	1.60E+01	1.43E+01	1.39E+01	4.53E+00	4.98E+00	3.31E+01
	SSIM	4.77E-01	6.24E-01	6.24E-01	6.77E-01	4.55E-01	5.28E-01	2.36E-01	2.54E-01	9.71E+02
	FSIM	7.16E-01	7.34E-01	7.29E-01	7.41E-01	7.05E-01	6.89E-01	4.65E-01	4.65E-01	1.04E+00
Im 3	MEAN	3.25E+01	3.16E+01	2.94E+01	2.73E+01	3.37E+01	2.67E+01	3.06E+01	2.99E+01	1.86E+01
	MSE	3.45E+03	1.54E+03	1.58E+03	2.14E+03	1.68E+03	1.13E+03	2.77E+04	2.68E+04	7.00E-01
	STD	1.00E+00	9.45E-01	7.80E-01	5.99E+00	1.08E+00	1.56E+00	1.25E+00	1.39E+00	7.76E-01
	PSNR	1.34E+01	1.69E+01	1.74E+01	1.57E+01	1.66E+01	1.82E+01	3.89E+00	3.91E+00	3.11E+01
	SSIM	5.34E-01	6.59E-01	6.65E-01	6.20E-01	6.23E-01	7.02E-01	2.05E-01	2.15E-01	1.14E+03
	FSIM	6.54E-01	7.37E-01	7.47E-01	7.26E-01	7.12E-01	7.78E-01	4.73E-01	4.63E-01	1.07E+00
Im 4	MEAN	3.46E+01	3.27E+01	3.08E+01	2.97E+01	3.30E+01	2.73E+01	3.27E+01	3.14E+01	3.60E+01
	MSE	6.31E+03	5.57E+03	1.78E+03	1.85E+03	1.97E+03	1.83E+03	6.81E+03	8.42E+03	1.37E+03
	STD	9.50E-01	7.69E-01	7.18E-01	6.36E+00	1.08E+00	1.59E+00	1.22E+00	1.45E+00	1.47E+00
	PSNR	1.20E+01	1.26E+01	1.63E+01	1.65E+01	1.55E+01	1.61E+01	9.94E+00	9.03E+00	1.78E+01
	SSIM	3.60E-01	4.42E-01	6.28E-01	6.80E-01	5.57E-01	6.19E-01	3.34E-01	2.41E-01	6.93E-01
	FSIM	6.60E-01	6.98E-01	7.87E-01	8.11E-01	7.81E-01	8.07E-01	4.86E-01	4.14E-01	8.00E-01

Table S22: *Results of AEFA variant and other algorithms at th=6.*

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 5	MEAN	3.33E+01	3.15E+01	2.88E+01	2.82E+01	3.53E+01	2.61E+01	3.13E+01	3.08E+01	1.76E+01
	MSE	5.80E+03	3.80E+03	1.11E+03	2.63E+03	1.51E+03	3.79E+03	9.27E+03	8.92E+03	7.43E-01
	STD	1.22E+00	8.13E-01	5.29E-01	5.88E+00	1.11E+00	1.30E+00	1.13E+00	1.24E+00	8.46E-01
	PSNR	1.32E+01	1.46E+01	1.86E+01	1.62E+01	1.65E+01	1.71E+01	8.59E+00	8.94E+00	3.13E+01
	SSIM	4.43E-01	5.74E-01	7.05E-01	6.44E-01	6.15E-01	6.32E-01	3.00E-01	3.21E-01	1.27E+03
	FSIM	6.94E-01	7.29E-01	7.88E-01	7.71E-01	7.56E-01	7.93E-01	5.38E-01	5.50E-01	1.73E+00
Im 6	MEAN	3.50E+01	3.31E+01	3.11E+01	2.89E+01	3.16E+01	2.88E+01	3.30E+01	3.22E+01	3.59E+01
	MSE	6.21E+03	3.27E+03	1.19E+03	2.49E+03	1.84E+03	3.86E+03	7.28E+03	7.69E+03	1.42E+03
	STD	8.93E-01	9.07E-01	4.76E-01	6.22E+00	1.01E+00	1.65E+00	1.27E+00	1.50E+00	1.43E+00
	PSNR	1.22E+01	1.45E+01	1.78E+01	1.63E+01	1.56E+01	1.50E+01	9.90E+00	9.35E+00	1.74E+01
	SSIM	3.72E-01	5.65E-01	7.08E-01	6.35E-01	5.74E-01	5.58E-01	3.23E-01	2.81E-01	6.40E-01
	FSIM	6.69E-01	7.66E-01	8.43E-01	7.64E-01	8.06E-01	7.55E-01	4.83E-01	4.49E-01	7.44E-01
Im 7	MEAN	3.34E+01	3.19E+01	2.87E+01	2.73E+01	3.23E+01	2.63E+01	3.10E+01	2.99E+01	3.41E+01
	MSE	1.68E+03	1.37E+03	1.26E+03	1.69E+03	1.59E+03	1.43E+03	2.93E+04	2.80E+04	1.10E+03
	STD	9.72E-01	9.31E-01	5.46E-01	5.92E+00	9.12E-01	1.57E+00	1.27E+00	1.21E+00	1.28E+00
	PSNR	1.66E+01	1.71E+01	1.78E+01	1.65E+01	1.69E+01	1.70E+01	3.56E+00	3.85E+00	1.81E+01
	SSIM	6.30E-01	6.59E-01	6.76E-01	6.36E-01	6.41E-01	6.50E-01	1.81E-01	2.02E-01	6.93E-01
	FSIM	7.06E-01	7.31E-01	7.72E-01	7.46E-01	7.23E-01	7.42E-01	4.60E-01	4.72E-01	7.93E-01
Im 8	MEAN	3.23E+01	3.05E+01	2.90E+01	2.73E+01	3.44E+01	2.63E+01	3.05E+01	2.93E+01	1.81E+01
	MSE	2.22E+03	2.24E+03	1.55E+03	1.81E+03	1.55E+03	2.48E+03	2.54E+04	2.84E+04	7.06E-01
	STD	1.05E+00	7.51E-01	8.76E-01	5.91E+00	1.24E+00	1.57E+00	1.27E+00	1.09E+00	7.99E-01
	PSNR	1.57E+01	1.52E+01	1.74E+01	1.62E+01	1.72E+01	1.46E+01	4.20E+00	3.67E+00	3.12E+01
	SSIM	5.92E-01	6.08E-01	6.66E-01	6.23E-01	6.46E-01	6.28E-01	2.13E-01	1.67E-01	2.19E+03
	FSIM	7.12E-01	7.23E-01	7.54E-01	7.35E-01	7.35E-01	7.41E-01	4.76E-01	4.64E-01	9.91E-01
Im 9	MEAN	3.19E+01	3.06E+01	2.96E+01	2.81E+01	3.38E+01	2.62E+01	2.99E+01	2.91E+01	3.40E+01
	MSE	2.23E+03	2.00E+03	1.26E+03	1.71E+03	1.20E+03	2.08E+03	2.23E+04	2.58E+04	1.49E+03
	STD	8.15E-01	7.43E-01	7.97E-01	5.94E+00	1.22E+00	1.37E+00	1.17E+00	1.22E+00	1.13E+00
	PSNR	1.55E+01	1.56E+01	1.76E+01	1.63E+01	1.83E+01	1.57E+01	4.75E+00	4.05E+00	1.68E+01
	SSIM	5.77E-01	6.27E-01	6.82E-01	6.41E-01	6.57E-01	6.17E-01	2.58E-01	2.11E-01	6.17E-01
	FSIM	7.33E-01	7.52E-01	7.81E-01	7.48E-01	7.74E-01	7.58E-01	4.93E-01	4.80E-01	7.21E-01
Im 10	MEAN	3.29E+01	3.10E+01	2.80E+01	2.60E+01	3.42E+01	2.67E+01	3.13E+01	3.01E+01	1.63E+01
	MSE	1.30E+03	1.97E+03	1.36E+03	1.69E+03	6.43E+02	2.09E+03	2.21E+04	2.46E+04	7.58E-01
	STD	8.27E-01	7.38E-01	2.71E-01	5.69E+00	1.08E+00	1.77E+00	1.24E+00	1.22E+00	8.36E-01
	PSNR	1.80E+01	1.58E+01	1.83E+01	1.64E+01	2.01E+01	1.51E+01	4.78E+00	4.36E+00	3.32E+01
	SSIM	6.39E-01	6.48E-01	7.09E-01	6.58E-01	7.26E-01	6.27E-01	2.69E-01	2.33E-01	1.44E+03
	FSIM	7.65E-01	7.51E-01	8.08E-01	7.62E-01	8.07E-01	7.61E-01	4.90E-01	4.88E-01	1.19E+00
Im 11	MEAN	3.29E+01	3.05E+01	2.90E+01	2.75E+01	3.23E+01	2.66E+01	3.02E+01	2.96E+01	3.34E+01
	MSE	1.92E+03	2.72E+03	1.70E+03	1.48E+03	1.26E+03	3.44E+03	2.01E+04	2.39E+04	1.59E+03
	STD	8.44E-01	7.25E-01	9.63E-01	5.84E+00	9.60E-01	1.53E+00	9.45E-01	1.26E+00	1.04E+00
	PSNR	1.72E+01	1.50E+01	1.73E+01	1.69E+01	1.84E+01	1.30E+01	5.25E+00	4.39E+00	1.69E+01
	SSIM	6.20E-01	6.35E-01	6.79E-01	6.74E-01	6.83E-01	5.25E-01	2.73E-01	2.07E-01	7.12E-01
	FSIM	7.45E-01	7.63E-01	7.92E-01	7.80E-01	7.87E-01	7.68E-01	5.09E-01	4.92E-01	8.30E-01

Table S23: Results of AEFA variant and other algorithms at $th=6$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 12	MEAN	3.34E+01	2.98E+01	3.05E+01	2.93E+01	3.44E+01	2.72E+01	3.03E+01	3.05E+01	1.78E+01
	MSE	2.83E+03	1.29E+03	1.64E+03	1.66E+03	1.23E+03	3.64E+03	1.88E+04	1.63E+04	7.79E-01
	STD	9.67E-01	8.21E-01	7.00E-01	5.99E+00	9.17E-01	1.66E+00	1.06E+00	1.17E+00	8.51E-01
	PSNR	1.38E+01	1.73E+01	1.64E+01	1.66E+01	1.75E+01	1.28E+01	5.49E+00	6.17E+00	3.28E+01
	SSIM	4.82E-01	6.83E-01	6.52E-01	6.95E-01	7.18E-01	5.14E-01	1.77E-01	2.70E-01	1.97E+03
	FSIM	8.20E-01	8.32E-01	8.38E-01	8.14E-01	8.48E-01	7.90E-01	4.44E-01	5.04E-01	9.79E-01
Im 13	MEAN	3.46E+01	3.22E+01	3.08E+01	2.92E+01	3.09E+01	2.81E+01	3.24E+01	3.16E+01	3.57E+01
	MSE	2.84E+03	2.48E+03	1.39E+03	2.87E+03	2.03E+03	2.06E+03	2.60E+04	2.50E+04	1.39E+03
	STD	6.46E-01	7.32E-01	4.24E-01	6.19E+00	1.12E+00	1.65E+00	1.39E+00	1.34E+00	9.47E-01
	PSNR	1.41E+01	1.48E+01	1.69E+01	1.43E+01	1.54E+01	1.53E+01	4.05E+00	4.22E+00	1.72E+01
	SSIM	4.45E-01	5.01E-01	6.11E-01	5.55E-01	4.92E-01	5.86E-01	1.37E-01	1.50E-01	6.62E-01
	FSIM	6.14E-01	6.10E-01	7.16E-01	6.48E-01	6.40E-01	6.86E-01	4.15E-01	4.18E-01	7.66E-01
Im 14	MEAN	3.39E+01	3.13E+01	3.16E+01	2.98E+01	3.52E+01	2.74E+01	3.19E+01	3.12E+01	1.75E+01
	MSE	1.80E+03	1.45E+03	1.06E+03	2.48E+03	1.66E+03	2.00E+03	2.46E+04	2.73E+04	6.90E-01
	STD	7.34E-01	6.13E-01	7.40E-01	6.23E+00	8.45E-01	1.43E+00	1.19E+00	1.06E+00	7.69E-01
	PSNR	1.57E+01	1.68E+01	1.82E+01	1.53E+01	1.60E+01	1.54E+01	4.34E+00	3.81E+00	3.24E+01
	SSIM	6.57E-01	7.28E-01	7.84E-01	7.24E-01	6.37E-01	6.89E-01	2.86E-01	2.37E-01	1.22E+03
	FSIM	8.04E-01	8.13E-01	8.43E-01	7.92E-01	8.11E-01	8.24E-01	5.83E-01	5.71E-01	1.06E+00
Im 15	MEAN	3.47E+01	3.23E+01	3.02E+01	3.03E+01	3.23E+01	2.73E+01	3.17E+01	3.04E+01	3.52E+01
	MSE	1.64E+03	1.41E+03	1.50E+03	1.08E+03	1.38E+03	2.23E+03	2.68E+04	2.65E+04	1.11E+03
	STD	9.43E-01	1.29E+00	4.02E-01	6.42E+00	1.06E+00	1.91E+00	1.14E+00	1.17E+00	1.28E+00
	PSNR	1.62E+01	1.72E+01	1.73E+01	1.83E+01	1.69E+01	1.48E+01	3.90E+00	3.92E+00	1.79E+01
	SSIM	7.05E-01	7.68E-01	7.73E-01	8.14E-01	7.46E-01	7.00E-01	2.46E-01	2.47E-01	6.83E-01
	FSIM	8.27E-01	8.44E-01	8.35E-01	8.62E-01	8.37E-01	8.26E-01	5.79E-01	5.72E-01	7.74E-01
Im 16	MEAN	3.38E+01	2.98E+01	2.92E+01	2.72E+01	3.47E+01	2.52E+01	3.07E+01	2.96E+01	1.75E+01
	MSE	2.00E+03	2.75E+03	2.57E+03	1.70E+03	1.26E+03	2.76E+03	1.48E+04	1.52E+04	6.80E-01
	STD	1.09E+00	8.78E-01	8.19E-01	5.52E+00	1.16E+00	1.79E+00	1.35E+00	1.16E+00	7.72E-01
	PSNR	1.64E+01	1.50E+01	1.43E+01	1.67E+01	1.81E+01	1.39E+01	6.49E+00	6.37E+00	3.45E+01
	SSIM	6.75E-01	6.61E-01	5.30E-01	7.50E-01	7.41E-01	5.08E-01	2.67E-01	2.57E-01	1.29E+03
	FSIM	8.01E-01	7.77E-01	8.13E-01	8.23E-01	8.27E-01	8.19E-01	5.29E-01	5.23E-01	1.60E+00
Im 17	MEAN	3.46E+01	3.14E+01	3.11E+01	2.95E+01	3.10E+01	2.74E+01	3.21E+01	3.11E+01	3.52E+01
	MSE	1.74E+03	1.92E+03	9.80E+02	1.57E+03	1.66E+03	3.35E+03	2.28E+04	2.72E+04	1.44E+03
	STD	9.03E-01	6.28E-01	7.26E-01	6.25E+00	8.47E-01	1.54E+00	1.34E+00	1.25E+00	1.11E+00
	PSNR	1.59E+01	1.62E+01	1.86E+01	1.67E+01	1.61E+01	1.35E+01	4.91E+00	3.84E+00	1.65E+01
	SSIM	7.05E-01	7.80E-01	8.21E-01	7.71E-01	7.10E-01	7.20E-01	3.33E-01	2.46E-01	6.58E-01
	FSIM	8.24E-01	8.38E-01	8.63E-01	8.12E-01	8.31E-01	8.20E-01	6.04E-01	5.85E-01	7.56E-01
Im 18	MEAN	3.49E+01	3.17E+01	3.13E+01	3.00E+01	3.51E+01	2.84E+01	3.20E+01	3.14E+01	1.77E+01
	MSE	1.97E+03	1.37E+03	1.90E+03	2.46E+03	1.85E+03	2.35E+03	2.73E+04	2.79E+04	7.13E-01
	STD	1.08E+00	1.15E+00	5.61E-01	6.30E+00	9.15E-01	1.87E+00	1.46E+00	1.39E+00	7.75E-01
	PSNR	1.52E+01	1.72E+01	1.62E+01	1.68E+01	1.55E+01	1.47E+01	3.82E+00	3.71E+00	3.24E+01
	SSIM	6.79E-01	7.74E-01	7.79E-01	7.64E-01	6.58E-01	7.20E-01	2.45E-01	2.36E-01	1.48E+03
	FSIM	8.10E-01	8.34E-01	8.33E-01	8.10E-01	8.04E-01	8.14E-01	5.56E-01	5.50E-01	1.26E+00

Table S24: *Results of AEFA variant and other algorithms at th=6.*

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 19	MEAN	3.35E+01	3.15E+01	3.01E+01	2.78E+01	3.31E+01	2.65E+01	3.12E+01	3.04E+01	3.47E+01
	MSE	2.16E+03	2.07E+03	1.33E+03	1.68E+03	2.00E+03	1.93E+03	2.17E+04	2.29E+04	1.27E+03
	STD	1.04E+00	8.57E-01	5.65E-01	5.96E+00	1.36E+00	1.49E+00	1.21E+00	1.33E+00	1.15E+00
	PSNR	1.50E+01	1.57E+01	1.71E+01	1.66E+01	1.52E+01	1.55E+01	4.88E+00	4.57E+00	1.74E+01
	SSIM	5.38E-01	6.27E-01	6.64E-01	6.45E-01	5.50E-01	6.06E-01	2.53E-01	2.24E-01	7.26E-01
	FSIM	7.09E-01	7.30E-01	7.62E-01	7.65E-01	7.16E-01	7.63E-01	5.17E-01	4.90E-01	7.71E-01
Im 20	MEAN	3.43E+01	3.21E+01	3.01E+01	2.93E+01	3.55E+01	2.68E+01	3.17E+01	3.10E+01	1.87E+01
	MSE	2.44E+03	2.04E+03	2.26E+03	1.33E+03	2.14E+03	1.54E+03	2.23E+04	2.09E+04	7.32E-01
	STD	8.98E-01	8.50E-01	4.19E-01	6.35E+00	1.10E+00	1.76E+00	1.20E+00	1.61E+00	7.63E-01
	PSNR	1.45E+01	1.56E+01	1.60E+01	1.73E+01	1.48E+01	1.66E+01	4.74E+00	5.03E+00	3.06E+01
	SSIM	5.26E-01	6.01E-01	6.29E-01	6.72E-01	5.31E-01	6.38E-01	1.97E-01	2.24E-01	2.10E+03
	FSIM	6.99E-01	7.28E-01	7.37E-01	7.73E-01	7.15E-01	7.70E-01	4.77E-01	4.90E-01	1.10E+00
Im 21	MEAN	3.42E+01	3.29E+01	3.01E+01	2.84E+01	3.24E+01	2.82E+01	3.25E+01	3.06E+01	3.55E+01
	MSE	2.53E+03	2.45E+03	1.58E+03	1.48E+03	2.13E+03	1.52E+03	2.00E+04	1.91E+04	1.22E+03
	STD	8.28E-01	7.17E-01	6.15E-01	6.07E+00	9.42E-01	1.90E+00	1.15E+00	1.30E+00	1.06E+00
	PSNR	1.44E+01	1.47E+01	1.75E+01	1.72E+01	1.49E+01	1.69E+01	5.18E+00	5.41E+00	1.75E+01
	SSIM	5.22E-01	5.80E-01	6.68E-01	6.79E-01	5.38E-01	6.51E-01	2.23E-01	2.44E-01	6.89E-01
	FSIM	7.08E-01	7.13E-01	7.67E-01	7.71E-01	7.22E-01	7.73E-01	4.79E-01	4.95E-01	7.70E-01
Im 22	MEAN	3.34E+01	3.27E+01	3.09E+01	2.89E+01	3.23E+01	2.71E+01	3.19E+01	3.13E+01	3.52E+01
	MSE	3.41E+03	2.36E+03	1.28E+03	2.15E+03	1.62E+03	1.70E+03	2.17E+04	2.17E+04	1.11E+03
	STD	4.88E-01	6.38E-01	6.27E-01	6.09E+00	1.05E+00	1.83E+00	1.19E+00	1.53E+00	1.28E+00
	PSNR	1.32E+01	1.46E+01	1.76E+01	1.51E+01	1.62E+01	1.65E+01	4.86E+00	4.92E+00	1.79E+01
	SSIM	5.04E-01	5.94E-01	6.73E-01	6.14E-01	6.06E-01	6.54E-01	2.12E-01	2.15E-01	6.83E-01
	FSIM	6.66E-01	7.08E-01	7.55E-01	7.49E-01	7.27E-01	7.75E-01	4.66E-01	4.60E-01	7.74E-01
Im 23	MEAN	3.36E+01	3.25E+01	3.04E+01	2.73E+01	3.14E+01	2.74E+01	3.09E+01	3.12E+01	3.45E+01
	MSE	2.25E+03	2.13E+03	9.01E+02	1.83E+03	1.57E+03	2.39E+03	2.40E+04	2.25E+04	1.36E+03
	STD	6.41E-01	9.19E-01	6.39E-01	5.75E+00	9.86E-01	1.53E+00	1.02E+00	1.42E+00	8.01E-01
	PSNR	1.54E+01	1.51E+01	1.87E+01	1.63E+01	1.63E+01	1.60E+01	4.36E+00	4.78E+00	1.75E+01
	SSIM	5.87E-01	6.07E-01	7.05E-01	6.72E-01	6.20E-01	6.65E-01	1.82E-01	2.14E-01	6.80E-01
	FSIM	6.96E-01	7.11E-01	7.79E-01	7.64E-01	7.37E-01	7.64E-01	4.83E-01	5.00E-01	7.72E-01
Im 24	MEAN	3.45E+01	3.41E+01	3.08E+01	3.02E+01	3.37E+01	2.85E+01	3.37E+01	3.24E+01	3.65E+01
	MSE	3.59E+03	2.60E+03	1.19E+03	1.82E+03	1.84E+03	1.94E+03	2.51E+04	2.46E+04	1.29E+03
	STD	6.44E-01	6.91E-01	3.01E-01	6.43E+00	9.41E-01	1.67E+00	1.23E+00	1.49E+00	1.60E+00
	PSNR	1.31E+01	1.42E+01	1.76E+01	1.61E+01	1.57E+01	1.56E+01	4.17E+00	4.30E+00	1.74E+01
	SSIM	3.97E-01	4.85E-01	6.73E-01	6.47E-01	5.18E-01	6.08E-01	1.01E-01	1.14E-01	6.58E-01
	FSIM	6.03E-01	6.44E-01	7.85E-01	7.81E-01	7.19E-01	7.50E-01	3.55E-01	3.68E-01	7.97E-01

Table S25: Results of AEFA variant and other algorithms at $th=6$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 25	MEAN	3.44E+01	3.06E+01	2.97E+01	2.82E+01	3.10E+01	2.77E+01	3.11E+01	3.02E+01	3.49E+01
	MSE	1.90E+03	1.73E+03	1.19E+03	1.78E+03	1.78E+03	1.87E+03	2.11E+04	2.61E+04	1.62E+03
	STD	1.17E+00	8.48E-01	6.51E-01	6.02E+00	1.23E+00	1.52E+00	1.30E+00	1.38E+00	1.11E+00
	PSNR	1.54E+01	1.61E+01	1.75E+01	1.62E+01	1.56E+01	1.56E+01	4.98E+00	4.02E+00	1.65E+01
	SSIM	5.71E-01	6.51E-01	6.85E-01	6.57E-01	5.80E-01	6.26E-01	2.85E-01	1.95E-01	6.58E-01
	FSIM	7.20E-01	7.41E-01	7.76E-01	7.59E-01	7.22E-01	7.69E-01	5.44E-01	4.81E-01	7.56E-01
Im 26	MEAN	3.40E+01	3.13E+01	2.90E+01	2.88E+01	3.47E+01	2.72E+01	3.18E+01	3.05E+01	3.15E+01
	MSE	1.43E+03	2.23E+03	1.08E+03	2.53E+03	1.59E+03	1.44E+03	2.07E+04	2.57E+04	1.40E+03
	STD	9.51E-01	6.16E-01	3.69E-01	5.99E+00	1.06E+00	1.31E+00	1.19E+00	1.44E+00	1.04E+00
	PSNR	1.68E+01	1.52E+01	1.81E+01	1.53E+01	1.64E+01	1.69E+01	5.05E+00	4.05E+00	1.77E+01
	SSIM	6.58E-01	6.26E-01	7.13E-01	6.52E-01	6.41E-01	6.80E-01	2.49E-01	1.65E-01	7.13E-01
	FSIM	7.34E-01	7.26E-01	7.87E-01	7.47E-01	7.31E-01	7.78E-01	5.01E-01	4.20E-01	7.75E-01
Im 27	MEAN	3.28E+01	3.19E+01	2.96E+01	2.84E+01	3.16E+01	2.70E+01	3.15E+01	3.15E+01	3.46E+01
	MSE	2.53E+03	2.41E+03	9.41E+02	1.60E+03	1.45E+03	1.96E+03	2.26E+04	2.15E+04	1.48E+03
	STD	4.94E-01	7.13E-01	5.79E-01	5.94E+00	8.95E-01	1.78E+00	1.31E+00	1.55E+00	1.26E+00
	PSNR	1.46E+01	1.48E+01	1.85E+01	1.68E+01	1.68E+01	1.54E+01	4.76E+00	4.91E+00	1.70E+01
	SSIM	5.68E-01	6.04E-01	6.91E-01	6.74E-01	6.40E-01	6.32E-01	2.18E-01	2.32E-01	6.77E-01
	FSIM	6.59E-01	6.86E-01	7.51E-01	7.42E-01	7.17E-01	7.46E-01	4.78E-01	4.94E-01	7.58E-01
Im 28	MEAN	3.44E+01	3.19E+01	2.98E+01	2.90E+01	3.41E+01	2.69E+01	3.19E+01	3.06E+01	3.21E+01
	MSE	1.97E+03	2.13E+03	1.31E+03	1.24E+03	2.11E+03	2.11E+03	2.18E+04	2.20E+04	1.27E+03
	STD	1.14E+00	7.40E-01	6.15E-01	6.02E+00	9.60E-01	1.57E+00	1.35E+00	1.39E+00	1.15E+00
	PSNR	1.55E+01	1.51E+01	1.75E+01	1.74E+01	1.51E+01	1.53E+01	4.81E+00	4.87E+00	1.74E+01
	SSIM	6.05E-01	6.43E-01	7.05E-01	6.93E-01	5.93E-01	6.32E-01	2.18E-01	2.15E-01	7.00E-01
	FSIM	7.26E-01	7.12E-01	7.71E-01	7.73E-01	7.18E-01	7.64E-01	4.90E-01	4.92E-01	7.71E-01
Im 29	MEAN	3.34E+01	3.20E+01	3.00E+01	2.78E+01	3.43E+01	2.73E+01	3.20E+01	3.05E+01	3.09E+01
	MSE	3.14E+03	2.41E+03	1.12E+03	1.94E+03	1.93E+03	1.74E+03	2.03E+04	2.00E+04	1.53E+03
	STD	8.87E-01	7.31E-01	8.86E-01	5.95E+00	8.65E-01	1.98E+00	1.26E+00	1.21E+00	1.02E+00
	PSNR	1.36E+01	1.45E+01	1.77E+01	1.61E+01	1.55E+01	1.59E+01	5.13E+00	5.17E+00	1.68E+01
	SSIM	5.66E-01	6.12E-01	7.07E-01	7.18E-01	6.27E-01	6.80E-01	2.97E-01	3.04E-01	6.92E-01
	FSIM	6.81E-01	7.17E-01	7.75E-01	7.63E-01	7.37E-01	7.73E-01	5.42E-01	5.39E-01	7.63E-01
Im 30	MEAN	3.30E+01	3.10E+01	2.97E+01	2.77E+01	3.06E+01	2.66E+01	3.10E+01	3.11E+01	3.48E+01
	MSE	3.66E+03	4.01E+03	1.75E+03	1.87E+03	2.52E+03	2.39E+03	1.61E+04	1.51E+04	2.10E+03
	STD	6.60E-01	5.79E-01	5.66E-01	5.77E+00	1.15E+00	1.41E+00	1.16E+00	1.45E+00	1.10E+00
	PSNR	1.30E+01	1.29E+01	1.60E+01	1.65E+01	1.43E+01	1.48E+01	6.15E+00	6.40E+00	1.60E+01
	SSIM	4.71E-01	4.80E-01	6.24E-01	6.41E-01	4.98E-01	5.78E-01	3.41E-01	3.73E-01	6.14E-01
	FSIM	7.54E-01	7.44E-01	8.00E-01	7.64E-01	7.75E-01	7.56E-01	5.46E-01	5.52E-01	7.85E-01

Table S26: *Results of AEFA variant and other algorithms at th=11.*

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 1	MEAN	5.50E+01	4.88E+01	5.13E+01	4.50E+01	5.58E+01	4.17E+01	4.79E+01	4.70E+01	1.82E+01
	MSE	2.19E+03	8.31E+02	8.29E+02	5.55E+02	1.80E+03	1.98E+03	1.75E+04	1.99E+04	7.27E-01
	STD	1.77E+00	1.56E+00	1.85E+00	9.55E+00	1.99E+00	1.91E+00	1.65E+00	1.82E+00	7.96E-01
	PSNR	1.48E+01	2.02E+01	1.93E+01	2.10E+01	1.58E+01	1.54E+01	5.93E+00	5.21E+00	5.60E+01
	SSIM	5.17E-01	7.18E-01	7.07E-01	7.68E-01	5.53E-01	5.88E-01	3.53E-01	3.22E-01	4.63E+02
	FSIM	7.26E-01	7.94E-01	7.85E-01	8.30E-01	7.32E-01	7.40E-01	5.08E-01	5.02E-01	1.86E+00
Im 2	MEAN	5.66E+01	5.20E+01	4.80E+01	4.42E+01	5.20E+01	4.02E+01	5.08E+01	4.96E+01	5.76E+01
	MSE	2.95E+03	1.64E+03	6.51E+02	6.87E+02	1.56E+03	1.43E+03	7.26E+03	6.69E+03	4.36E+02
	STD	1.80E+00	1.57E+00	1.15E+00	9.51E+00	1.80E+00	1.91E+00	1.58E+00	2.24E+00	2.03E+00
	PSNR	1.50E+01	1.80E+01	2.06E+01	2.06E+01	1.65E+01	1.88E+01	9.73E+00	1.01E+01	2.21E+01
	SSIM	5.26E-01	7.26E-01	7.97E-01	8.28E-01	6.10E-01	7.19E-01	3.05E-01	3.34E-01	8.34E-01
	FSIM	7.55E-01	8.53E-01	8.89E-01	8.94E-01	8.23E-01	8.48E-01	4.60E-01	4.80E-01	8.92E-01
Im 3	MEAN	5.38E+01	4.92E+01	4.72E+01	4.20E+01	5.49E+01	3.96E+01	4.76E+01	4.73E+01	1.92E+01
	MSE	2.07E+03	1.01E+03	4.77E+02	8.30E+02	1.53E+03	1.64E+03	2.68E+04	2.59E+04	7.06E-01
	STD	1.90E+00	1.73E+00	1.50E+00	8.72E+00	2.03E+00	2.34E+00	1.62E+00	2.15E+00	7.84E-01
	PSNR	1.57E+01	1.85E+01	2.15E+01	1.98E+01	1.73E+01	1.72E+01	3.96E+00	4.04E+00	5.14E+01
	SSIM	6.15E-01	6.96E-01	7.45E-01	7.14E-01	6.45E-01	7.17E-01	2.18E-01	2.26E-01	6.79E+02
	FSIM	7.14E-01	7.69E-01	8.17E-01	7.99E-01	7.36E-01	7.91E-01	4.74E-01	4.65E-01	1.78E+00
Im 4	MEAN	5.31E+01	4.98E+01	4.71E+01	4.20E+01	5.20E+01	4.18E+01	4.82E+01	4.70E+01	5.43E+01
	MSE	4.48E+03	1.03E+03	7.01E+02	5.02E+02	3.60E+03	2.03E+03	1.70E+04	1.70E+04	5.50E+02
	STD	1.59E+00	1.89E+00	1.34E+00	8.84E+00	1.73E+00	2.26E+00	1.57E+00	1.89E+00	2.25E+00
	PSNR	1.19E+01	1.92E+01	2.03E+01	2.18E+01	1.30E+01	1.60E+01	5.88E+00	6.00E+00	2.14E+01
	SSIM	4.24E-01	7.07E-01	7.26E-01	7.66E-01	4.70E-01	6.25E-01	2.73E-01	2.80E-01	7.64E-01
	FSIM	6.43E-01	7.40E-01	7.76E-01	8.14E-01	6.69E-01	7.42E-01	4.50E-01	4.46E-01	8.02E-01
Im 5	MEAN	5.47E+01	4.81E+01	4.62E+01	4.44E+01	5.65E+01	4.07E+01	4.84E+01	4.70E+01	2.07E+01
	MSE	1.44E+03	9.00E+02	7.75E+02	4.55E+02	1.05E+03	2.22E+03	8.48E+03	8.82E+03	7.99E-01
	STD	1.92E+00	1.38E+00	9.39E-01	9.16E+00	2.23E+00	2.33E+00	1.78E+00	2.07E+00	9.00E-01
	PSNR	1.67E+01	1.91E+01	1.96E+01	2.21E+01	1.82E+01	1.97E+01	9.18E+00	8.80E+00	5.19E+01
	SSIM	6.28E-01	7.33E-01	7.47E-01	8.45E-01	6.90E-01	7.44E-01	3.36E-01	3.16E-01	7.33E+02
	FSIM	7.66E-01	8.17E-01	8.30E-01	9.07E-01	8.09E-01	8.44E-01	5.52E-01	5.40E-01	2.14E+00
Im 6	MEAN	5.68E+01	5.20E+01	5.14E+01	4.50E+01	5.25E+01	4.15E+01	4.99E+01	4.84E+01	5.74E+01
	MSE	1.80E+03	1.92E+03	8.09E+02	9.47E+02	1.78E+03	4.15E+03	7.23E+03	7.47E+03	5.79E+02
	STD	1.82E+00	1.68E+00	1.81E+00	9.49E+00	1.75E+00	2.48E+00	1.48E+00	1.96E+00	2.50E+00
	PSNR	1.58E+01	1.79E+01	2.02E+01	1.99E+01	1.58E+01	1.56E+01	9.74E+00	9.58E+00	2.10E+01
	SSIM	5.70E-01	7.22E-01	7.84E-01	8.01E-01	5.73E-01	5.50E-01	3.13E-01	2.94E-01	7.44E-01
	FSIM	7.98E-01	8.54E-01	8.79E-01	8.74E-01	7.97E-01	7.48E-01	4.82E-01	4.59E-01	8.32E-01
Im 7	MEAN	5.37E+01	4.98E+01	4.58E+01	4.23E+01	5.53E+01	4.04E+01	4.78E+01	4.71E+01	4.89E+01
	MSE	1.97E+03	7.48E+02	5.89E+02	6.81E+02	1.13E+03	1.79E+03	2.71E+04	2.81E+04	5.54E+02
	STD	1.66E+00	1.86E+00	1.07E+00	9.17E+00	1.84E+00	2.24E+00	1.48E+00	2.10E+00	2.09E+00
	PSNR	1.63E+01	2.01E+01	2.08E+01	2.04E+01	1.82E+01	1.61E+01	3.85E+00	3.66E+00	2.14E+01
	SSIM	6.17E-01	7.31E-01	7.34E-01	7.34E-01	6.74E-01	6.66E-01	2.08E-01	1.97E-01	7.83E-01
	FSIM	7.08E-01	8.04E-01	8.25E-01	8.23E-01	7.49E-01	7.47E-01	4.61E-01	4.58E-01	8.60E-01

Table S27: Results of AEFA variant and other algorithms at $th=11$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 8	MEAN	5.32E+01	4.82E+01	4.61E+01	4.07E+01	5.49E+01	4.03E+01	4.67E+01	4.55E+01	2.19E+01
	MSE	2.19E+03	9.78E+02	5.31E+02	6.90E+02	7.55E+02	1.87E+03	2.22E+04	2.47E+04	8.07E-01
	STD	2.05E+00	1.85E+00	1.31E+00	8.91E+00	2.19E+00	2.51E+00	1.51E+00	1.65E+00	8.60E-01
	PSNR	1.60E+01	1.87E+01	2.11E+01	2.05E+01	1.94E+01	1.62E+01	4.84E+00	4.26E+00	5.22E+01
	SSIM	6.08E-01	6.92E-01	7.38E-01	7.41E-01	6.99E-01	6.89E-01	2.58E-01	2.19E-01	9.67E+02
	FSIM	7.26E-01	7.58E-01	8.06E-01	8.14E-01	7.64E-01	7.77E-01	4.91E-01	4.68E-01	2.53E+00
Im 9	MEAN	5.26E+01	4.81E+01	4.69E+01	4.21E+01	5.42E+01	3.93E+01	4.73E+01	4.63E+01	5.57E+01
	MSE	1.79E+03	7.47E+02	5.78E+02	4.73E+02	8.38E+02	1.88E+03	2.36E+04	2.01E+04	4.92E+02
	STD	1.55E+00	1.49E+00	1.27E+00	9.06E+00	1.84E+00	2.10E+00	1.85E+00	1.66E+00	2.02E+00
	PSNR	1.73E+01	2.01E+01	2.13E+01	2.20E+01	1.95E+01	1.62E+01	4.44E+00	5.19E+00	2.16E+01
	SSIM	6.40E-01	7.42E-01	7.76E-01	7.88E-01	6.98E-01	6.86E-01	2.42E-01	2.92E-01	7.81E-01
	FSIM	7.78E-01	8.15E-01	8.46E-01	8.58E-01	7.96E-01	7.84E-01	4.87E-01	5.00E-01	8.43E-01
Im 10	MEAN	5.37E+01	4.85E+01	4.74E+01	4.11E+01	5.55E+01	4.11E+01	4.77E+01	4.67E+01	2.16E+01
	MSE	5.58E+02	1.11E+03	4.74E+02	7.92E+02	4.97E+02	2.20E+03	2.28E+04	2.46E+04	8.61E-01
	STD	1.65E+00	1.44E+00	1.62E+00	8.92E+00	2.14E+00	2.27E+00	1.82E+00	1.77E+00	8.97E-01
	PSNR	2.15E+01	1.87E+01	2.16E+01	2.02E+01	2.14E+01	1.52E+01	4.67E+00	4.27E+00	5.46E+01
	SSIM	7.74E-01	7.26E-01	7.74E-01	7.52E-01	7.51E-01	6.26E-01	2.63E-01	2.40E-01	5.15E+02
	FSIM	8.43E-01	8.02E-01	8.57E-01	8.37E-01	8.29E-01	7.61E-01	4.97E-01	4.85E-01	2.49E+00
Im 11	MEAN	5.31E+01	4.81E+01	4.50E+01	4.16E+01	5.39E+01	4.16E+01	4.83E+01	4.58E+01	4.87E+01
	MSE	8.28E+02	7.22E+02	4.32E+02	6.71E+02	1.40E+03	1.81E+03	2.14E+04	1.96E+04	8.64E+02
	STD	1.62E+00	1.15E+00	9.94E-01	8.60E+00	1.69E+00	2.66E+00	2.04E+00	1.76E+00	1.81E+00
	PSNR	2.02E+01	2.00E+01	2.21E+01	2.07E+01	1.91E+01	1.64E+01	4.86E+00	5.33E+00	2.01E+01
	SSIM	7.25E-01	7.59E-01	7.93E-01	7.70E-01	6.79E-01	6.86E-01	2.54E-01	2.75E-01	7.99E-01
	FSIM	8.05E-01	8.25E-01	8.54E-01	8.43E-01	8.05E-01	8.00E-01	4.93E-01	4.97E-01	8.67E-01
Im 12	MEAN	5.45E+01	4.46E+01	4.73E+01	4.32E+01	5.59E+01	4.02E+01	4.66E+01	4.57E+01	2.14E+01
	MSE	1.66E+03	8.30E+02	1.30E+03	6.63E+02	1.24E+03	3.19E+03	1.64E+04	1.69E+04	8.67E-01
	STD	2.08E+00	5.74E-01	1.40E+00	8.86E+00	2.21E+00	2.17E+00	1.57E+00	1.58E+00	8.98E-01
	PSNR	1.65E+01	1.97E+01	1.79E+01	2.11E+01	1.77E+01	1.35E+01	6.02E+00	5.91E+00	5.50E+01
	SSIM	6.47E-01	7.63E-01	7.17E-01	7.96E-01	7.09E-01	5.94E-01	2.32E-01	2.28E-01	9.39E+02
	FSIM	8.50E-01	8.70E-01	8.61E-01	8.89E-01	8.56E-01	8.09E-01	4.69E-01	4.60E-01	2.18E+00
Im 13	MEAN	5.59E+01	5.02E+01	4.96E+01	4.51E+01	5.01E+01	4.15E+01	4.96E+01	4.89E+01	5.73E+01
	MSE	2.42E+03	1.13E+03	6.77E+02	5.22E+02	1.69E+03	1.74E+03	2.25E+04	2.40E+04	8.24E+02
	STD	1.68E+00	1.37E+00	1.28E+00	9.63E+00	2.18E+00	1.98E+00	1.73E+00	1.96E+00	2.43E+00
	PSNR	1.46E+01	1.81E+01	2.03E+01	2.16E+01	1.63E+01	1.59E+01	4.74E+00	4.42E+00	1.92E+01
	SSIM	4.83E-01	6.51E-01	7.03E-01	7.92E-01	5.31E-01	6.19E-01	1.86E-01	1.63E-01	7.24E-01
	FSIM	6.43E-01	7.34E-01	7.79E-01	8.44E-01	6.64E-01	7.37E-01	4.23E-01	4.19E-01	7.98E-01
Im 14	MEAN	5.52E+01	4.79E+01	5.03E+01	4.66E+01	5.59E+01	4.21E+01	4.89E+01	4.78E+01	1.88E+01
	MSE	1.33E+03	1.03E+03	6.00E+02	7.51E+02	1.06E+03	1.83E+03	2.68E+04	2.04E+04	7.21E-01
	STD	1.27E+00	1.27E+00	1.75E+00	9.90E+00	1.43E+00	2.55E+00	1.43E+00	1.84E+00	7.93E-01
	PSNR	1.72E+01	1.90E+01	2.08E+01	2.00E+01	1.85E+01	1.58E+01	3.86E+00	5.16E+00	5.12E+01
	SSIM	6.96E-01	7.65E-01	8.45E-01	8.22E-01	7.51E-01	7.03E-01	2.47E-01	3.80E-01	6.33E+02
	FSIM	8.34E-01	8.45E-01	8.80E-01	8.70E-01	8.55E-01	8.33E-01	5.73E-01	6.11E-01	2.27E+00

Table S28: *Results of AEFA variant and other algorithms at th=11.*

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 15	MEAN	5.47E+01	4.81E+01	4.95E+01	4.58E+01	5.21E+01	3.99E+01	4.95E+01	4.83E+01	5.63E+01
	MSE	1.17E+03	9.94E+02	5.05E+02	6.07E+02	1.53E+03	2.32E+03	2.14E+04	2.31E+04	8.43E+02
	STD	1.60E+00	1.25E+00	1.67E+00	9.88E+00	1.70E+00	2.17E+00	1.85E+00	2.19E+00	2.49E+00
	PSNR	1.80E+01	1.91E+01	2.13E+01	2.06E+01	1.66E+01	1.52E+01	4.97E+00	4.63E+00	1.93E+01
	SSIM	7.47E-01	8.15E-01	8.66E-01	8.40E-01	7.22E-01	7.38E-01	3.58E-01	3.21E-01	7.22E-01
	FSIM	8.53E-01	8.64E-01	8.94E-01	8.71E-01	8.37E-01	8.40E-01	6.03E-01	5.96E-01	7.92E-01
Im 16	MEAN	5.33E+01	4.75E+01	4.35E+01	4.18E+01	5.54E+01	4.05E+01	4.63E+01	4.58E+01	1.95E+01
	MSE	7.44E+02	1.84E+03	1.38E+03	1.24E+03	1.02E+03	2.40E+03	1.41E+04	1.36E+04	7.46E-01
	STD	2.02E+00	1.49E+00	3.46E-01	8.88E+00	2.00E+00	2.01E+00	1.40E+00	1.80E+00	7.99E-01
	PSNR	1.95E+01	1.65E+01	1.90E+01	1.80E+01	1.86E+01	1.49E+01	6.75E+00	6.83E+00	5.69E+01
	SSIM	8.18E-01	6.87E-01	7.26E-01	7.76E-01	7.70E-01	5.82E-01	2.91E-01	3.05E-01	7.31E+02
	FSIM	8.42E-01	8.35E-01	8.57E-01	8.69E-01	8.24E-01	8.33E-01	5.41E-01	5.36E-01	1.68E+00
Im 17	MEAN	5.58E+01	5.00E+01	5.07E+01	4.47E+01	5.26E+01	4.19E+01	4.85E+01	4.76E+01	5.63E+01
	MSE	1.08E+03	7.48E+02	6.63E+02	1.27E+03	1.12E+03	2.20E+03	2.32E+04	2.45E+04	9.60E+02
	STD	2.01E+00	2.29E+00	1.67E+00	9.50E+00	1.90E+00	2.16E+00	1.60E+00	1.86E+00	2.35E+00
	PSNR	1.82E+01	2.04E+01	2.00E+01	1.87E+01	1.83E+01	1.52E+01	4.56E+00	4.31E+00	1.85E+01
	SSIM	7.62E-01	7.96E-01	8.43E-01	8.24E-01	7.72E-01	7.62E-01	3.25E-01	2.98E-01	7.33E-01
	FSIM	8.57E-01	8.56E-01	8.71E-01	8.57E-01	8.55E-01	8.42E-01	5.91E-01	5.87E-01	7.86E-01
Im 18	MEAN	5.55E+01	4.91E+01	5.09E+01	4.65E+01	5.66E+01	4.15E+01	4.95E+01	4.79E+01	2.04E+01
	MSE	1.36E+03	8.87E+02	5.81E+02	4.46E+02	1.31E+03	1.79E+03	2.46E+04	2.61E+04	7.79E-01
	STD	1.69E+00	1.40E+00	1.25E+00	1.00E+01	1.96E+00	2.00E+00	1.68E+00	1.99E+00	8.24E-01
	PSNR	1.72E+01	1.94E+01	2.07E+01	2.19E+01	1.71E+01	1.65E+01	4.35E+00	4.02E+00	5.31E+01
	SSIM	7.40E-01	8.19E-01	8.70E-01	8.76E-01	7.37E-01	7.65E-01	3.04E-01	2.70E-01	7.76E+02
	FSIM	8.33E-01	8.63E-01	8.88E-01	8.94E-01	8.38E-01	8.45E-01	5.80E-01	5.60E-01	2.64E+00
Im 19	MEAN	5.34E+01	4.97E+01	4.63E+01	4.17E+01	5.00E+01	4.03E+01	4.87E+01	4.64E+01	5.48E+01
	MSE	2.00E+03	1.17E+03	1.10E+03	6.04E+02	1.84E+03	1.97E+03	2.12E+04	2.18E+04	7.39E+02
	STD	1.71E+00	1.41E+00	1.28E+00	8.97E+00	1.76E+00	2.30E+00	1.74E+00	1.76E+00	1.83E+00
	PSNR	1.53E+01	1.85E+01	1.80E+01	2.10E+01	1.55E+01	1.57E+01	4.94E+00	4.82E+00	1.99E+01
	SSIM	5.50E-01	7.04E-01	6.83E-01	7.60E-01	5.62E-01	6.50E-01	2.59E-01	2.48E-01	7.98E-01
	FSIM	7.15E-01	7.85E-01	7.70E-01	8.32E-01	7.24E-01	7.70E-01	5.23E-01	5.13E-01	8.17E-01
Im 20	MEAN	5.49E+01	5.06E+01	4.79E+01	4.27E+01	5.58E+01	4.11E+01	4.91E+01	4.79E+01	1.88E+01
	MSE	1.96E+03	8.91E+02	8.11E+02	6.09E+02	1.54E+03	1.81E+03	1.98E+04	1.83E+04	7.46E-01
	STD	1.70E+00	1.59E+00	1.42E+00	9.31E+00	1.95E+00	2.56E+00	1.53E+00	2.06E+00	8.09E-01
	PSNR	1.52E+01	1.92E+01	1.91E+01	2.11E+01	1.65E+01	1.63E+01	5.43E+00	5.68E+00	5.04E+01
	SSIM	5.56E-01	7.27E-01	7.20E-01	7.71E-01	6.11E-01	6.64E-01	2.53E-01	2.81E-01	6.36E+02
	FSIM	7.27E-01	8.00E-01	7.90E-01	8.49E-01	7.41E-01	7.69E-01	4.97E-01	5.13E-01	2.67E+00
Im 21	MEAN	5.45E+01	5.11E+01	4.73E+01	4.36E+01	5.12E+01	4.25E+01	4.97E+01	4.79E+01	5.63E+01
	MSE	2.25E+03	1.03E+03	6.43E+02	6.93E+02	1.93E+03	1.61E+03	1.99E+04	2.09E+04	6.33E+02
	STD	1.62E+00	1.75E+00	8.66E-01	9.42E+00	1.78E+00	1.87E+00	1.59E+00	1.66E+00	2.27E+00
	PSNR	1.52E+01	1.92E+01	2.04E+01	2.04E+01	1.53E+01	1.67E+01	5.24E+00	4.98E+00	2.05E+01
	SSIM	5.65E-01	7.34E-01	7.58E-01	7.60E-01	5.65E-01	6.96E-01	2.30E-01	2.08E-01	7.55E-01
	FSIM	7.17E-01	7.92E-01	8.22E-01	8.31E-01	7.31E-01	7.90E-01	4.90E-01	4.75E-01	8.21E-01

Table S29: Results of AEFA variant and other algorithms at $th=11$.

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 22	MEAN	5.42E+01	5.08E+01	4.89E+01	4.33E+01	5.21E+01	4.26E+01	4.95E+01	4.82E+01	5.62E+01
	MSE	2.37E+03	1.52E+03	7.33E+02	5.75E+02	1.47E+03	1.34E+03	2.00E+04	2.01E+04	8.43E+02
	STD	1.47E+00	1.47E+00	1.33E+00	9.20E+00	1.89E+00	2.45E+00	1.57E+00	2.07E+00	2.49E+00
	PSNR	1.52E+01	1.70E+01	1.96E+01	2.09E+01	1.66E+01	1.72E+01	5.15E+00	5.26E+00	1.93E+01
	SSIM	5.75E-01	6.90E-01	7.30E-01	7.81E-01	6.25E-01	7.07E-01	2.32E-01	2.43E-01	7.22E-01
	FSIM	7.06E-01	7.79E-01	8.05E-01	8.48E-01	7.40E-01	8.07E-01	4.72E-01	4.83E-01	7.92E-01
Im 23	MEAN	5.40E+01	5.07E+01	4.68E+01	4.24E+01	5.50E+01	4.13E+01	4.93E+01	4.79E+01	4.96E+01
	MSE	1.55E+03	1.05E+03	7.96E+02	3.71E+02	1.24E+03	1.05E+03	1.84E+04	2.02E+04	7.80E+02
	STD	1.62E+00	1.64E+00	1.01E+00	9.28E+00	1.61E+00	1.95E+00	1.75E+00	2.01E+00	1.62E+00
	PSNR	1.67E+01	1.83E+01	1.93E+01	2.25E+01	1.74E+01	1.85E+01	5.57E+00	5.17E+00	1.95E+01
	SSIM	6.33E-01	7.24E-01	7.25E-01	8.08E-01	6.55E-01	7.36E-01	2.80E-01	2.49E-01	7.46E-01
	FSIM	7.21E-01	7.73E-01	7.91E-01	8.73E-01	7.35E-01	8.16E-01	5.23E-01	5.11E-01	7.99E-01
Im 24	MEAN	5.68E+01	5.25E+01	4.99E+01	4.79E+01	5.25E+01	4.12E+01	5.14E+01	5.05E+01	5.78E+01
	MSE	2.27E+03	1.37E+03	6.38E+02	6.62E+02	2.03E+03	1.53E+03	2.25E+04	2.13E+04	7.31E+02
	STD	1.47E+00	1.65E+00	8.43E-01	1.03E+01	1.81E+00	2.09E+00	1.53E+00	2.25E+00	1.68E+00
	PSNR	1.51E+01	1.71E+01	2.07E+01	2.04E+01	1.55E+01	1.67E+01	4.70E+00	4.93E+00	2.00E+01
	SSIM	4.84E-01	6.48E-01	7.74E-01	7.63E-01	4.99E-01	6.76E-01	1.41E-01	1.56E-01	7.48E-01
	FSIM	6.83E-01	7.75E-01	8.62E-01	8.52E-01	6.97E-01	7.79E-01	3.83E-01	3.94E-01	8.49E-01
Im 25	MEAN	5.42E+01	4.85E+01	4.73E+01	4.27E+01	5.54E+01	4.04E+01	4.80E+01	4.70E+01	4.98E+01
	MSE	1.42E+03	9.52E+02	1.12E+03	6.84E+02	1.40E+03	1.72E+03	2.24E+04	2.36E+04	9.60E+02
	STD	2.03E+00	1.49E+00	1.30E+00	9.04E+00	1.85E+00	2.36E+00	1.87E+00	2.08E+00	2.35E+00
	PSNR	1.67E+01	1.90E+01	1.77E+01	2.10E+01	1.68E+01	1.64E+01	4.73E+00	4.44E+00	1.85E+01
	SSIM	6.27E-01	7.28E-01	6.96E-01	7.66E-01	6.32E-01	6.39E-01	2.66E-01	2.38E-01	7.33E-01
	FSIM	7.29E-01	7.95E-01	7.71E-01	8.41E-01	7.32E-01	7.58E-01	5.40E-01	5.13E-01	7.86E-01
Im 26	MEAN	5.39E+01	4.97E+01	4.59E+01	4.32E+01	5.01E+01	4.01E+01	4.80E+01	4.66E+01	5.57E+01
	MSE	1.49E+03	1.19E+03	5.67E+02	8.36E+02	8.35E+02	1.65E+03	2.05E+04	2.21E+04	6.53E+02
	STD	1.51E+00	1.57E+00	7.65E-01	9.10E+00	1.85E+00	2.48E+00	1.50E+00	1.78E+00	1.91E+00
	PSNR	1.69E+01	1.79E+01	2.11E+01	1.97E+01	1.90E+01	1.64E+01	5.06E+00	4.77E+00	2.04E+01
	SSIM	6.56E-01	7.28E-01	7.83E-01	7.68E-01	7.33E-01	6.77E-01	2.52E-01	2.25E-01	7.79E-01
	FSIM	7.25E-01	7.86E-01	8.32E-01	8.24E-01	7.60E-01	7.89E-01	5.05E-01	4.68E-01	8.24E-01
Im 27	MEAN	5.33E+01	5.02E+01	4.61E+01	4.39E+01	5.50E+01	4.07E+01	4.87E+01	4.77E+01	5.22E+01
	MSE	1.55E+03	1.10E+03	8.02E+02	9.54E+02	1.36E+03	1.93E+03	2.33E+04	2.09E+04	7.76E+02
	STD	1.07E+00	1.67E+00	8.15E-01	9.52E+00	1.69E+00	2.46E+00	1.61E+00	2.11E+00	2.64E+00
	PSNR	1.64E+01	1.82E+01	1.96E+01	1.91E+01	1.72E+01	1.60E+01	4.47E+00	4.99E+00	1.96E+01
	SSIM	6.30E-01	7.06E-01	7.42E-01	7.62E-01	6.50E-01	6.71E-01	1.99E-01	2.41E-01	7.56E-01
	FSIM	6.99E-01	7.66E-01	7.95E-01	8.12E-01	7.27E-01	7.73E-01	4.96E-01	5.07E-01	7.97E-01
Im 28	MEAN	5.41E+01	5.06E+01	4.63E+01	4.40E+01	5.00E+01	4.13E+01	4.86E+01	4.75E+01	5.56E+01
	MSE	1.61E+03	8.79E+02	6.29E+02	4.97E+02	1.45E+03	1.61E+03	2.12E+04	2.16E+04	7.39E+02
	STD	1.66E+00	1.91E+00	7.56E-01	9.70E+00	2.06E+00	2.31E+00	1.56E+00	2.08E+00	1.83E+00
	PSNR	1.67E+01	1.89E+01	2.04E+01	2.15E+01	1.67E+01	1.64E+01	4.94E+00	4.81E+00	1.99E+01
	SSIM	6.54E-01	7.50E-01	7.73E-01	8.06E-01	6.51E-01	6.91E-01	2.29E-01	2.19E-01	7.98E-01
	FSIM	7.33E-01	7.94E-01	8.26E-01	8.55E-01	7.45E-01	7.69E-01	5.03E-01	4.91E-01	8.17E-01

Table S30: *Results of AEFA variant and other algorithms at $th=11$.*

No.	Metrics	AEO	AOA	CGSA	ChOA	fdbSOS	MFO	MPSO	TACPSO	iAEFA
Im 29	MEAN	5.42E+01	5.10E+01	4.59E+01	4.41E+01	5.12E+01	4.08E+01	4.95E+01	4.83E+01	5.61E+01
	MSE	2.32E+03	1.03E+03	7.16E+02	5.75E+02	1.54E+03	1.22E+03	1.78E+04	1.87E+04	1.08E+03
	STD	1.46E+00	1.37E+00	7.43E-01	9.33E+00	1.71E+00	2.43E+00	1.65E+00	2.14E+00	2.36E+00
	PSNR	1.52E+01	1.85E+01	2.02E+01	2.14E+01	1.69E+01	1.78E+01	5.83E+00	5.50E+00	1.88E+01
	SSIM	6.14E-01	7.37E-01	7.72E-01	8.03E-01	6.74E-01	7.46E-01	3.49E-01	3.30E-01	7.46E-01
	FSIM	7.21E-01	7.86E-01	8.18E-01	8.43E-01	7.51E-01	8.13E-01	5.65E-01	5.47E-01	8.09E-01
Im 30	MEAN	5.44E+01	4.97E+01	4.51E+01	4.21E+01	5.55E+01	4.01E+01	4.83E+01	4.72E+01	5.04E+01
	MSE	2.21E+03	1.30E+03	1.02E+03	6.37E+02	2.02E+03	1.72E+03	1.46E+04	1.24E+04	6.36E+02
	STD	1.94E+00	1.31E+00	8.84E-01	8.91E+00	1.80E+00	2.31E+00	1.73E+00	1.86E+00	2.67E+00
	PSNR	1.51E+01	1.77E+01	1.92E+01	2.15E+01	1.55E+01	1.61E+01	6.54E+00	7.29E+00	2.05E+01
	SSIM	5.51E-01	6.91E-01	7.04E-01	8.09E-01	5.71E-01	6.39E-01	3.88E-01	4.48E-01	7.91E-01
	FSIM	7.82E-01	7.92E-01	8.27E-01	8.60E-01	7.96E-01	7.95E-01	5.45E-01	6.01E-01	8.54E-01