Integerization

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- Tried using integerization for box blur, gaussian blur, sharpening
- SSIM and PSNR

Different Bit width - SSIM and PSNR

Here in matlab the data type is int8 but the value calculation is done assuming for int6,int4,int2.

		Int 2	int4	int6	int8
Box Blur	SSIM	1	1	1	0.9983
	PSNR	84.1208	84.1208	84.1208	47.1488
Gaussian Blur	SSIM	0.9226	0.9982	0.9980	0.9978
	PSNR	16.2907	41.9047	53.4330	52.2763
Sharpening	SSIM	0.4083	0.8572	0.9909	0.9995
	PSNR	6.8467	12.8008	23.8897	49.0330

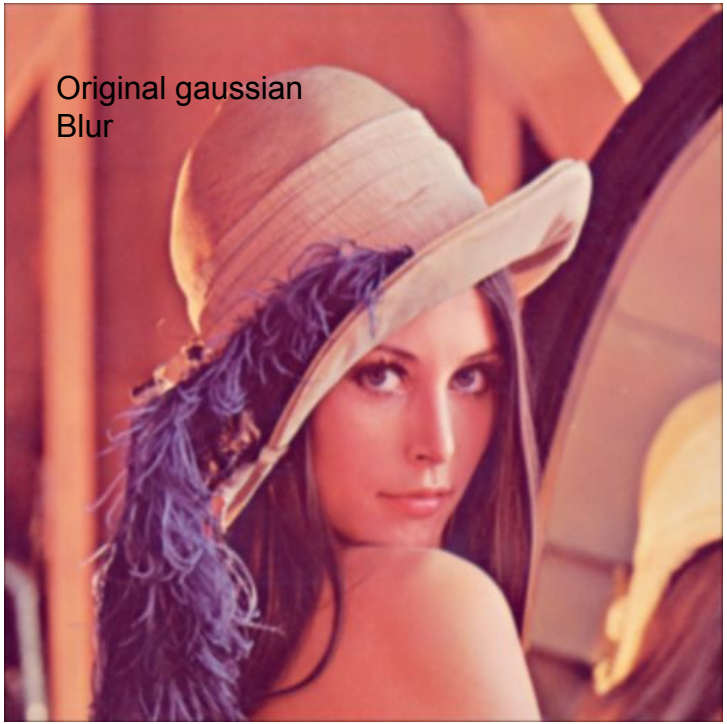
Original image

BOX BLUR

BOX BLUR

PSNR value : 46.7424

Gaussian blur



Gaussian Blur

PSNR value: 52.1209

Sharpening

Sharpening

PSNR value: 48.2950

Original Grayscale image

BOX BLUR GRAYSCALE

BOX BLUR GRAYSCALE

SSIM = 0.9983

PSNR = 47.1488

Gaussian Blur Grayscale

Gaussian Blur Grayscale

SSIM = 0.9978

PSNR = 52.2763

Sharpening Grayscale

Sharpening Grayscale

SSIM = 0.9995

PSNR = 49.0330

Summary Table

Image Processing	SSIM	PSNR RGB	PSNR Grayscale
Box Blur	0.9983	46.7424	47.1488
Gaussian Blur	0.9978	52.1209	52.2763
Sharpening	0.9995	48.2950	49.0330

Utilization Comparison

	Only Convolution	Convolution with Integerization
LUT	990	66875
FF	1128	2413
DSP	5	7
SRL	1	38
SLICE	0	0
CP achieved post-synthesis	8.214	8.692

Summary Table

	Only Convolution, kernel is Floating point	Convolution with Integerization for int4	Convolution with Integerization for int2
LUT	990	1766	1744
FF	1128	1758	1756
DSP	5	7	7
SRL	0	37	37
SLICE	0	0	0
CP achieved post-synthesis	8.214	8.692	8.692

Try with int 2

And don’t multiply with alpha

New Summary Table - post synthesis and place and route - image 512 x 512

	Convolution, kernel is Floating point, For box blur kernel	Convolution with Integerization - int4, For Box blur kernel	Convolution withIntegerization - int8, For Box blur kernel
LUT	897	327	327
FF	1063	540	540
DSP	5	4	4
SRL	1	1	1
SLICE	329	154	154
Clock period - achieved post-synthesis	8.214 ns	5.629 ns	5.629 ns
Clock period - achieved post-implementation	8.740 ns	6.267 ns	6.267 ns

New Summary Table - post synthesis and place and route - image 512 x 512

	Convolution, kernel is Floating point, For gaussian kernel	Convolution with Integerization - int4, For gaussian kernel	Convolution withIntegerization - int8, For gaussian kernel
LUT	906	331	329
FF	1067	545	544
DSP	5	4	4
SRL	1	1	1
SLICE	352	149	153
Clock period - achieved post-synthesis	8.214 ns	5.629 ns	5.629 ns
Clock period - achieved post-implementation	8.573 ns	5.946 ns	6.016 ns

Updated Different Bit width - SSIM and PSNR

Here in matlab the data type is int8 but the value calculation is done assuming for int6,int4,int2. If int8 means we need to multiply with 2^6 rather not 2^7 to accommodate few values

		Int 2	int4	int6	int8
Box Blur	SSIM	1	1	1	1
	PSNR	84.1208	84.1208	84.1208	84.1208
Gaussian Blur	SSIM	0.9176	0.9971	0.9983	0.9980
	PSNR	16.3032	41.6645	39.5890	53.4330
Sharpening	SSIM	0.4083	0.0576	0.9524	0.9968
	PSNR	6.8467	6.1041	17.6845	29.5341

New Summary Table - post synthesis and place and route - updated for image size 256 x 256

	Convolution, kernel is Floating point, For gaussian kernel -512 x 512	Convolution with Integerization - int4, For gaussian kernel Used pragma pipeline here	Convolution with Integerization - int4, For gaussian kernel Didn't use pragma pipeline here
LUT	906	767	384
FF	1067	558	531
DSP	5	21	4
SRL	1	0	0
SLICE	352	261	157
Clock period - achieved post-synthesis	8.214 ns	6.594 ns	5.629 ns
Clock period - achieved post-implementation	8.573 ns	8.561 ns	6..624 ns

New Summary Table - post synthesis and place and route - updated for image size 128x128

	Convolution, kernel is Floating point, For gaussian kernel -512 x 512	Convolution with Integerization - int4, For gaussian kernel Didn’t use pragma pipeline here
LUT	906	377
FF	1067	517
DSP	5	4
SRL	1	0
SLICE	352	152
Clock period - achieved post-synthesis	8.214 ns	5.629 ns
Clock period - achieved post-implementation	8.573 ns	6..261 ns