

**By Gavin Jampani, Eish Kapoor,
& Vivek Ponnala**

*Under Advisory of Dr. Ling(Happy
Birthday!!!)*



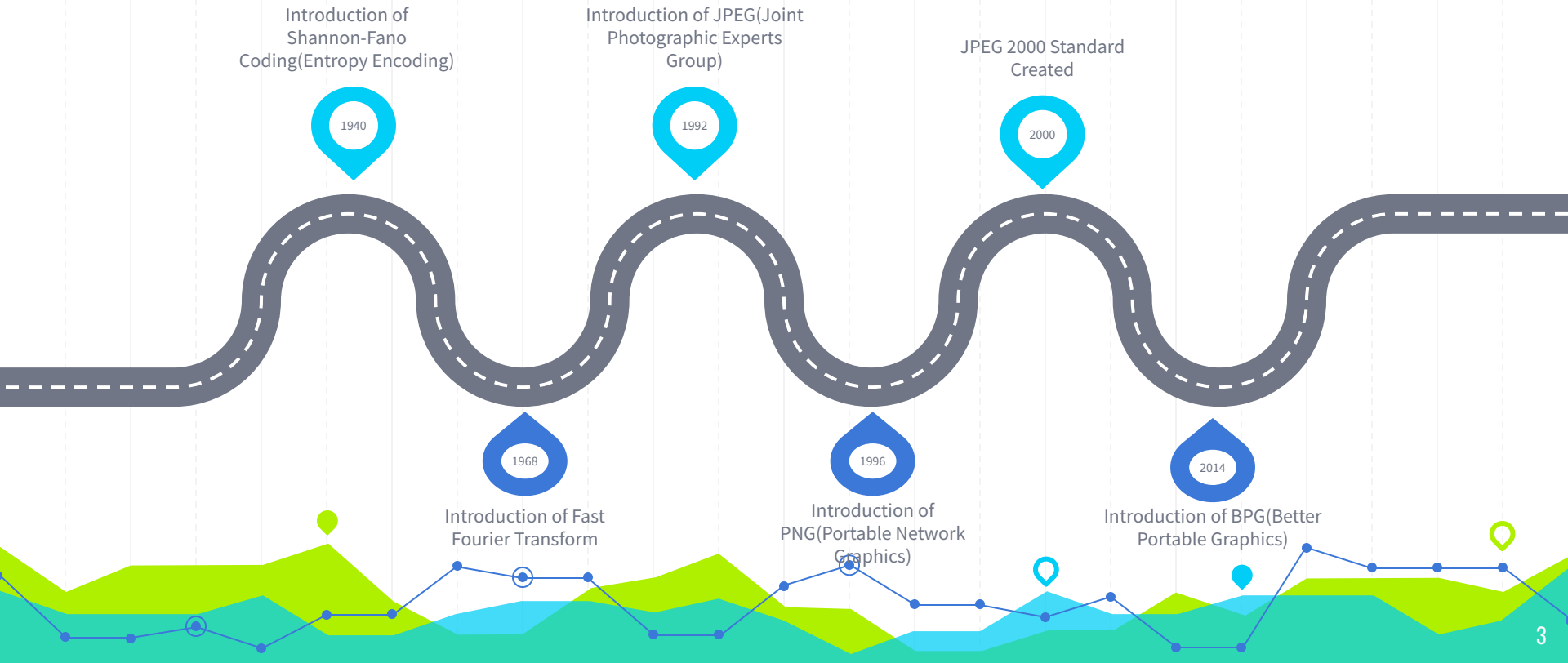
BPG & JPEG: Analysis

PRESENTATION AGENDA

- Image Compression
 - Background
 - What Led to JPEG & BPG
- What is BPG?
 - Steps
 - Profile
- JPEG Refresher
- JPEG vs BPG Format Comparison
 - Results
- Reflection & Next Steps

WHAT IS IMAGE COMPRESSION?

Data Compression applied to images to reduce cost of storage/transmission



WHAT IS BPG?

Origin

- Created by Fabrice Bellard
- Created as successor to JPEG
- Intended to be for low memory, high portability

Basic Background

- Based on HEVC Standard(intra)
- No built-in native support for BPG in any mainstream browsers
- Not royalty free, covered by some HEVC patents

Support

- Supports Lossy & Lossless Compression
- Different Color Spaces(RBG, CMYK, YCbCr)
- Different Color Depths(8,10,10-Bit)

BPG Technologies

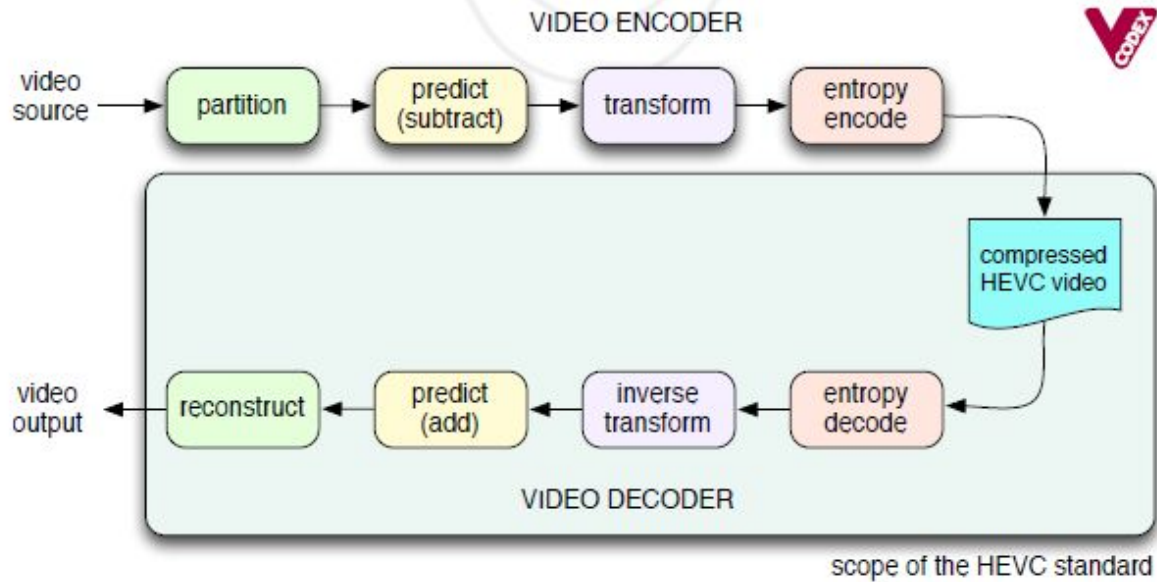


Figure 2: Structure of an HEVC encoder and decoder

BPG Algorithm

● Initialization Phase

- Images passed in can have different pixel depth, color spaces, & alpha channel
- Checks for essential requirements(bit depth of 8, true color/grayscale color spaces)

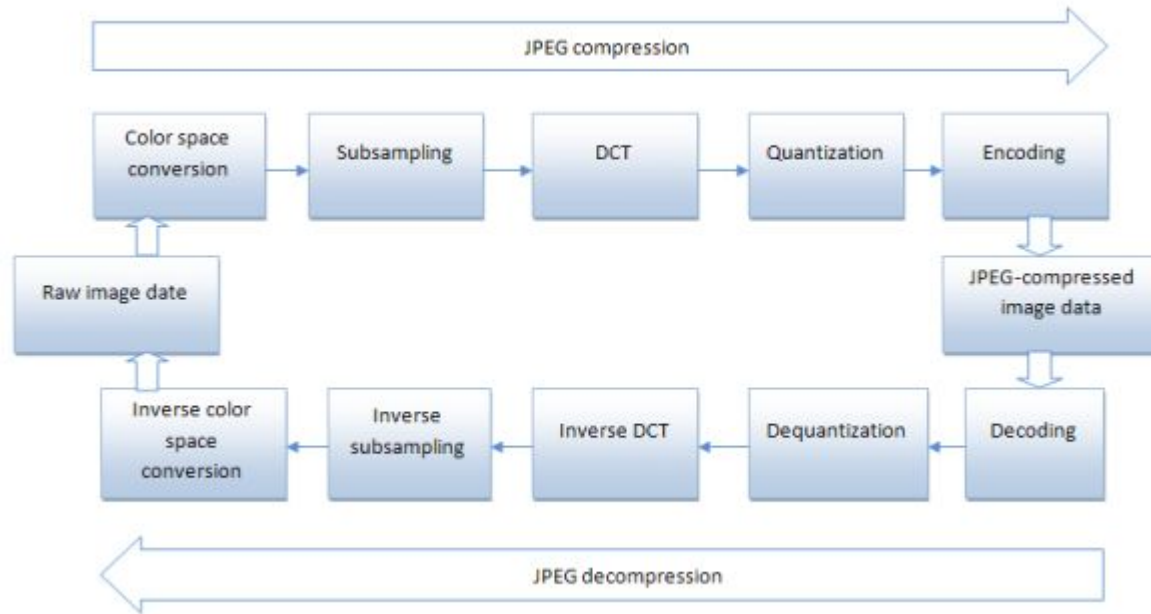
● Prediction

- Partitioning
- Intra-prediction using DC prediction, planar prediction, and/or directional prediction

BPG Algorithm

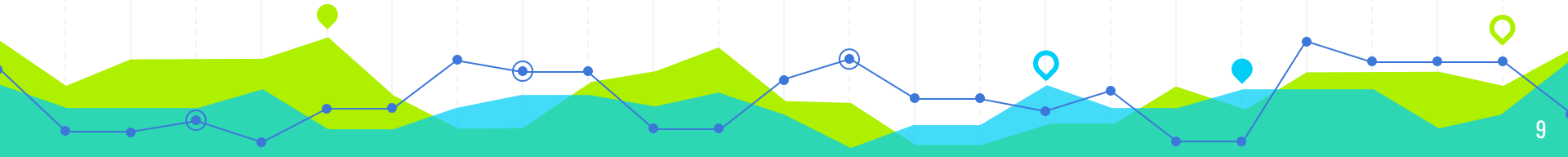
- Transform and Quantization
 - uses integer DCT and DST transforms with varied block sizes between 4×4 and 32×32
 - supports frequency-dependent quantization by using quantization matrices for all transform block sizes
- Entropy Encoding
 - Uses CABAC(Context-Based Adaptive Binary Arithmetic Coding)
 - Eliminate redundancy left after prediction stage

JPEG Refresher



Format Comparison Analysis: Experiment Design

- 18 images
 - RGB & Grayscale
 - 8-Bit, 16-Bit, 16-Bit Linear
- Metrics
 - Compression Ratio, PSNR, MSE, & RMSE



Procedure and implementation

- Converting format
- Passing through encoder
- Setting augments
- Writing script



Results for gray8bit

mode	Format	Images encoded	CR	PSNR(db)	MSE(db)	RMSE(db)
BPG	<u>gray8bit</u>	city.png	13.24	32.66	35.24	5.936
	<u>gray8bit</u>	fireworks.png	13.20	40.48	5.8208	2.412
	<u>gray8bit</u>	flower.png	25.04	41.12	5.024	2.241
JPEG	<u>gray8bit</u>	city.bmp	12.87	34.59	22.60	4.753
	<u>gray8bit</u>	fireworks.bmp	77.85	39.02	8.143	2.854
	<u>gray8bit</u>	flower.bmp	24.64	45.90	1.671	1.292

Results for gray16bit

mode	Format	Images encoded	CR	PSNR(db)	MSE(db)	RMSE(db)
BPG	<u>gray16bit</u>	city.png	43.64	80.79	35.79	5.980
	<u>gray16bit</u>	fireworks.png	68.2	88.36	6.258	2.502
	<u>gray16bit</u>	flower.png	188.9	89.11	5.270	2.290
JPEG	<u>gray16bit</u>	city.bmp	12.78	82.79	22.60	4.760
	<u>gray16bit</u>	fireworks.bmp	77.57	87.16	8.261	2.874
	<u>gray16bit</u>	flower.bmp	24.83	94.16	1.647	1.283

Results for gray16bitlinear

mode	Format	Images encoded	CR	PSNR(db)	MSE(db)	RMSE(db)
BPG	gray16bitlinear	city.png	173.7	86.06	10.63	3.260
	gray16bitlinear	fireworks.png	91.89	90.24	4.057	2.014
	gray16bitlinear	flower.png	225.4	94.84	1.409	1.187
JPEG	gray16bitlinear	city.bmp	75.16	86.86	8.860	2.977
	gray16bitlinear	fireworks.bmp	115.8	87.07	8.433	2.903
	gray16bitlinear	flower.bmp	177.7	108.8	0.057	0.239

Results for rgb8bit

mode	Format	Images encoded	CR	PSNR(db)	MSE(db)	RMSE(db)
BPG	<u>rgb8bit</u>	city.png	7.125	32.04	40.66	6.376
	<u>rgb8bit</u>	fireworks.png	14.57	39.48	7.323	2.706
	<u>rgb8bit</u>	flower.png	32.05	41.03	5.124	2.260
JPEG	<u>rgb8bit</u>	city.bmp	9.86	29.35	75.48	8.688
	<u>rgb8bit</u>	fireworks.bmp	69.86	34.71	21.87	4.688
	<u>rgb8bit</u>	flower.bmp	73.76	35.87	16.83	4.103

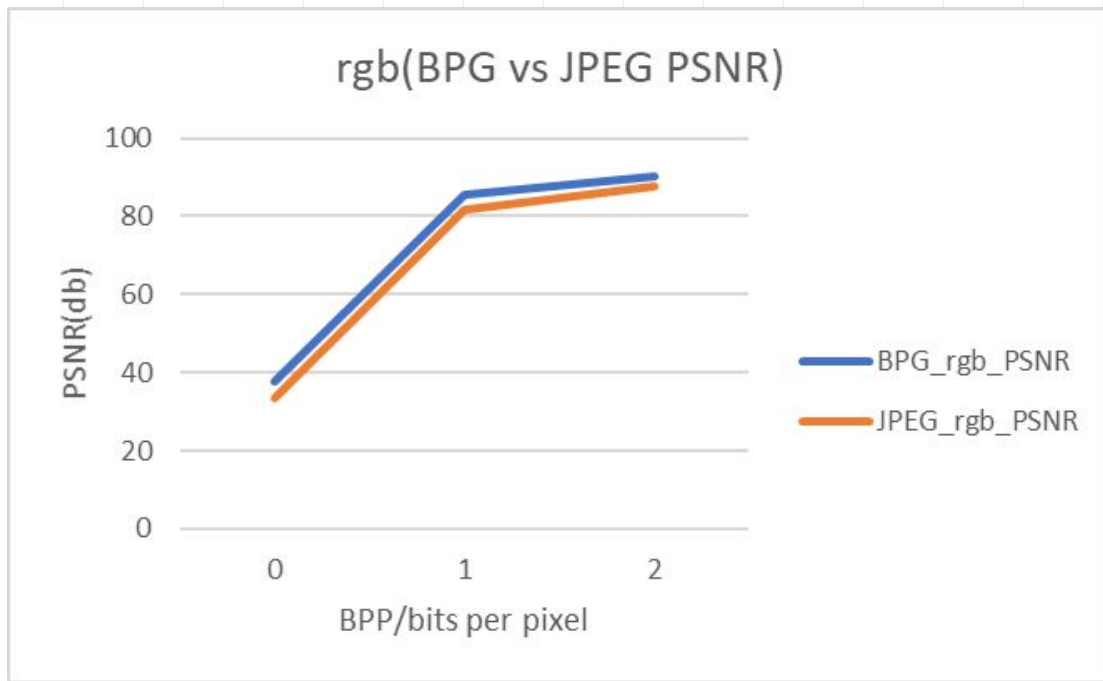
Results for rgb16bit

mode	Format	Images encoded	CR	PSNR(db)	MSE(db)	RMSE(db)
BPG	rgb16bit	city.png	21.01	80.21	40.91	6.396
	rgb16bit	fireworks.png	53.68	87.61	7.446	2.728
	rgb16bit	flower.png	148.38	89.00	5.406	2.325
JPEG	rgb16bit	city.bmp	9.859	77.55	75.48	8.688
	rgb16bit	fireworks.bmp	69.86	82.91	21.97	4.688
	rgb16bit	flower.bmp	73.75	84.07	16.83	4.103

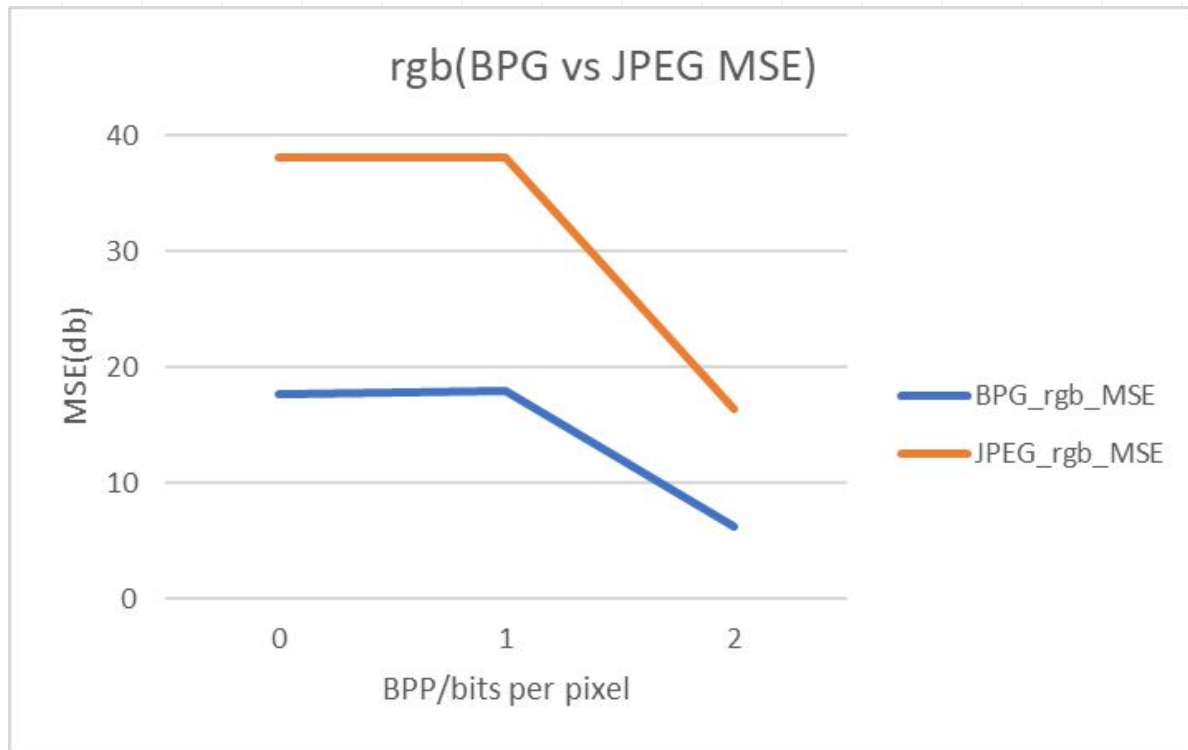
Results for rgb16bitlinear

mode	Format	Images encoded	CR	PSNR(db)	MSE(db)	RMSE(db)
BPG	<u>rgb16bitlinear</u>	city.png	106.56	84.99	13.61	3.689
	<u>rgb16bitlinear</u>	fireworks.png	94.15	90.37	3.943	1.986
	<u>rgb16bitlinear</u>	flower.png	206.9	94.94	1.376	1.173
JPEG	<u>rgb16bitlinear</u>	city.bmp	15.99	82.98	21.61	4.649
	<u>rgb16bitlinear</u>	fireworks.bmp	100	82.00	27.11	5.206
	<u>rgb16bitlinear</u>	flower.bmp	111.3	98.42	0.6184	0.7864

PSNR



MSE



BPG Image Comparision



JPEG Image



BPG vs. JPEG COMPARISON

BPG

- .)Compression ratio
- .)PSNR
- .)MSE
- .)Overall performance

JPEG

- .)Compression ratio
- .)PSNR
- .)MSE
- .)Overall performance



Reflection & Next Steps

- Image formats
- Quantization
- Block size
- Transforms
- Encoding
- Compression Type



THANKS!

Any questions?

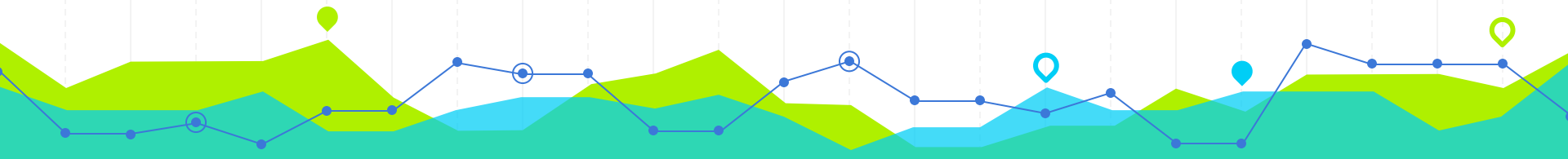
Contact Us?

vponnala@scu.edu gjampani@scu.edu ekapoor@scu.edu



Sources

- https://imagecompression.info/test_images/
- <https://www.jpeg.io/>
- <https://www.vcodex.com/hevc-an-introduction-to-high-efficiency-coding/>
- A. Baviskar, S. Ashtekar and A. Chintawar, "Performance evaluation of high quality image compression techniques," *2014 International Conference on Advances in Computing, Communications and Informatics (ICACCI)*, 2014, pp. 1986-1990, doi: 10.1109/ICACCI.2014.6968643.
- <https://medium.com/breaktheloop/jpeg-compression-algorithm-969af03773da>



Implementation/Demo