Low-Latency Lossless Video Compression Methods for Multi-camera Systems

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Introduction

Multi-camera System

- 3D vision
- Depth calculation
- Image mosaicing for higher overall resolution
- 360° omnidirectional video
- View interpolation

8 x 5 MP Multi-camera with 4 x GigE

Problems

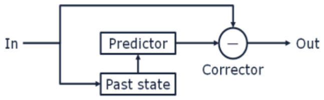
- High bandwidth requirement
- High storage

Challenge

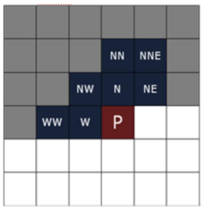
- Real-time

Lossless compression algorithms

- Reducing bandwidth usage
- Preserving image detail
- In hardware
  - Real-time compression
  - Low latency
  - No frame buffers
- Spatial prediction algorithm

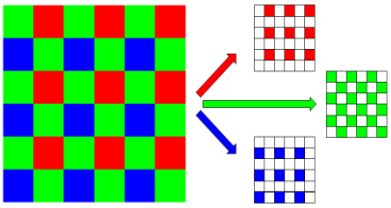


Context-based, adaptive lossless image coding
CALIC
P = Gradient-adjusted prediction

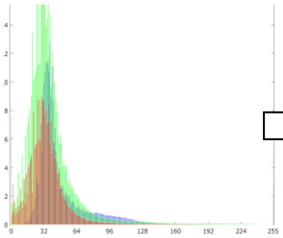


CALIC

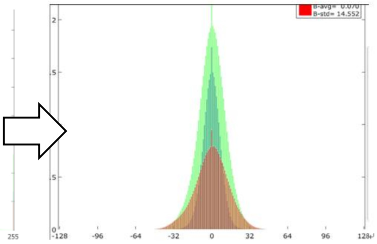
Color filter array



Bayer pattern



raw histogram

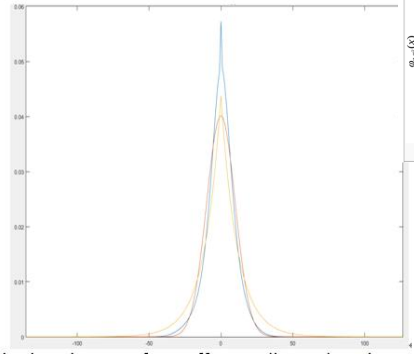


error-corrective values are close to zero

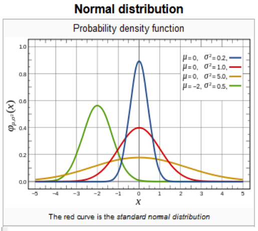
Improvements

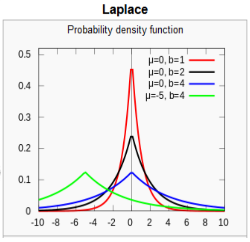
- Find optimal probability density function
- Gaussian, Laplace
- Transmit only parameters
- Average, standard deviation, …
- Quick calculation
- Possible use of previous frame or line

Sacrifice of perfect Huffman table



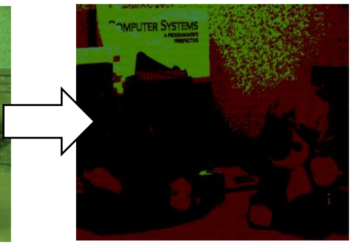
Blue line is real one, perfect Huffman coding, red one is Gaussian, yellow one is Laplace





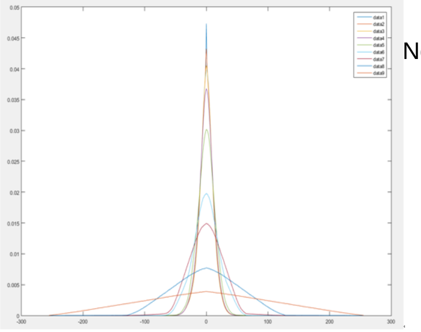
overflow---The bright or dark part of image

Raw Bayer image



Overflow

Noise estimation



Noise

- Improve compression by reducing needed bits
- adding the noise from 1bit to 8bits

The top one is adding one bit noise, and the second one is adding two bits noise… The bottom one is adding 8 bits.