Improving colour camera picture quality with oversampling

Jerome Avenel, Technical manager,
Image sensing solutions,
Sony SES

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Oversampling colour camera technology
Oversampling cameras

Camera is using sensor with higher resolution than output resolution

Examples:
- 20Mp sensor with 4K (8Mp) output
- 8Mp sensor with FHD (2Mp) output
Benefit of oversampling color camera: Resolution (1)

Mono sensor camera uses color filter on each pixel

Pattern: Bayer array
- Good color reproduction
- Good horizontal/vertical resolution
- Dual green pixel to keep higher sensitivity
Benefit of oversampling color camera: Resolution (2)

Debayering/demoisaicing is required, to extrapolate pixels and create RGB value for each pixel

Demosaic Artefacts: moire, zig-zag effect on edges
  • Requires filtering and advanced algorithm (Bilinear, spline interpolation, super resolution alg)
  • Impacting the resolution: Typically, resolution is reduced by 1/3
  ➢ Using oversampling cameras keeps full resolution on output
Benefit of oversampling cameras: Noise

More pixels on same size sensor means smaller pixels size
Sensitivity of pixel is typically related to \((\text{Pixel size})^2\).

Noise of combined pixels:
- When \(N\) pixels are combined together, SNR increase by \(\sqrt{N}\)

Overall, Noise level mainly depend on sensor size, not pixel size, for same resolution output

(Simplified explanation)
Examples: UHD 4K (8Mp) output cameras
Comparison 4K (8Mp) output camera

20.5Mp Sensor

8.5Mp sensor

8.9Mp sensor
Comparison 4K cameras sharpness

20.5Mp sensor

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Comparison 4K cameras sharpness

- 20.5Mp sensor
- 8.5Mp sensor
- 8.9Mp sensor
Comparison 4K cameras sharpness

- 20.5Mp sensor
- 8.5Mp sensor
- 8.9Mp sensor
Low light performance: 0.2lux, Cropped Image

- 8.9Mp sensor 1/2.3” (4K output)
- 8.5Mp sensor 1/2.5” (4K output)
- 20.5Mp sensor 1” (4K output)
- 2.1Mp sensor 1/2.8” (FHD output)

Lowest 4K noise

Highest sensitivity
Examples: FHD (2Mp) output cameras
FHD output examples: Artefacts

8.5Mp sensor, FHD output

2.1Mp sensor, FHD output

No Moire

Sharp details
Details in textures

Moiré (colours appearing on textures)

Unsharp details
FHD output examples, Sharpness

- 8.9Mp sensor
- 8.5Mp sensor
- 2.1Mp sensor with Optical Low Pass Filter
- 2.1Mp sensor
FHD output examples, Sharpness, cropped 1

- 8.9Mp sensor
- 8.5Mp sensor
- 2.1Mp sensor with OLPF
- 2.1Mp sensor
FHD output examples, Sharpness, cropped 2

- 8.9Mp sensor
- 8.5Mp sensor
- 2.1Mp sensor with OLPF
- 2.1Mp sensor
FHD output examples, Sharpness, cropped 3

8.9Mp sensor

8.5Mp sensor

2.1Mp sensor with OLPF

2.1Mp sensor
Sony autofocus camera modules
Using oversampling technology
FCB-ES8230

- **High resolution 4K 30p**
  - Ultra HD 2160p29.97 resolution
  - 20Mp sensor to provide highest 4K quality

- **Large size sensor**
  - 1” Exmor R sensor
  - Artistic flexibility for Broadcast applications

- **High quality lens**
  - 12x zoom, 18x Super resolution zoom
  - High quality lens

- **High quality picture**
  - Advanced processor
  - Many image adjustments (Gamma, sharpness tuning, color matrix...)

- **Optical Image stabilizer**
  - Optical image stabilizer
  - No reduction of resolution and angle of view

- **Feature rich**
  - 3D Noise Reduction, Visibility Enhancer, De-fog, E-flip,
  - Privacy zone Masking, ND filter, IR Cut Removal

- **HDMI output**
  - Simple interfacing
  - Backward compatible with FCB-ER8300 interface
## FCB-ER8530HD

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>1080p60</strong></td>
<td>• 1080p59.97 video mode, Exmor R sensor</td>
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<tr>
<td></td>
<td>• FCB with highest Detection/ Recognition/ Identification range</td>
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<tr>
<td><strong>High opt. zoom &amp; SRZ</strong></td>
<td>• 20x zoom</td>
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<td></td>
<td>• 40x Super resolution zoom</td>
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<td><strong>High image quality</strong></td>
<td>• Very high sharpness by using 8Mp sensor</td>
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<td></td>
<td>• Advanced image processor with lens compensation</td>
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<td><strong>Compact size</strong></td>
<td>• 50x60x93.3 mm</td>
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<td></td>
<td>• Similar size as FCB-EV7520</td>
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<tr>
<td><strong>Image stabilizer</strong></td>
<td>• Electronic image stabilizer</td>
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<td><strong>Feature rich</strong></td>
<td>• 3D Noise Reduction, Visibility Enhancer, De-fog, E-flip, E-Pan/Tilt</td>
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<td>• Privacy zone Masking, IR Cut Removal...</td>
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<td><strong>HDMI output</strong></td>
<td>• Simple interfacing</td>
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<td>• Perfect for future transition to 4K FCB-ER8530</td>
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